APPROVED BY SENATE
02/04/2013

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Proposal to the Senate Educational Policy Committee

PROPOSAL TITLE: Establish a Graduate Concentration in Energy Systems within the Major in Engineering in the Master of Engineering Degree in the College of Engineering

SPONSOR: Professor James Stubbins, Department Head, Nuclear, Plasma, and Radiological Engineering, 217-333-2295, jstubbin@illinois.edu

COLLEGE CONTACT: Victoria L. Coverstone, Associate Dean, Office of Graduate and Professional Programs, College of Engineering, 265-4561, vcc@illinois.edu

BRIEF DESCRIPTION:

This proposal is for the creation of a Concentration in Energy Systems as the first concentration established for the Major in Engineering in the Master of Engineering (M.Eng.) degree being proposed by the College of Engineering (CoE). A concentration is required for the M.Eng. degree program with a Major in Engineering. Companion proposals for the Major in Engineering in the M.Eng. and for the overall M.Eng. are provided. The Energy Systems Concentration is professionally oriented and aimed at providing students more depth and breadth in energy systems than possible in a B.S. degree. Concentrations in the M.Eng. must have a designated home unit. The designated home unit for the Energy Systems Concentration will be the department of Nuclear, Plasma and Radiological Engineering (NPRE). Admissions, advising, and course and degree requirements will be administered by a director representing NPRE and the committee or a subset of the committee appointed by the CoE to provide oversight to the Energy Systems Concentration and the current Graduate Option in Energy and Sustainability Engineering (EaSE). The concentration is comprised of 32 hours organized as follows:

- ENG 471—Seminar in Energy and Sustainability (1 hour) and ENG 571—Theory of Energy and Sustainability Engineering (3 hours)
- 12 hours from a selected primary field
- 6 hours from a chosen secondary field
- 4 hours of professional development selected from a choice of a practicum, project, or 4 credit hours of course work from the Topical Breadth course list or other advisor approved course meeting the requirements for Professional Development.
- 3 hours from an approved list of courses providing topical breadth
- 3 hours of electives from approved list of courses or graduate level courses taken as prerequisite for required courses
- At least 16 hours must be at the 500 level

JUSTIFICATION:

It is more commonplace than not that private firms and public sector agencies and laboratories involved in energy deal with multiple aspects of energy systems. Managers often need an understanding of these different aspects, and most people employed in the area are, at some time, involved in projects or communicate with colleagues working across traditional disciplinary lines. It is difficult within the context of undergraduate degree programs to obtain the desired degree of breadth of background for working in such environments. Existing post-graduate CoE degree programs are often heavily dependent on research grant support and thus are focused on research and require three or more semesters to complete. The Energy Systems Concentration within the M.Eng. degree is designed to provide the workplace and students with the alternative of a professionally oriented degree accessible to students either funding their own education or supplemented with external internship-oriented support with completion possible within one year.

HISTORICAL BACKGROUND:
Up through the 1960's, many U.S. universities offered "professional master's" degrees in engineering, usually with the title "Master of Engineering," "Master of Engineering in Mechanical Engineering," "Master of Civil Engineering," etc., which distinguished them from the "Master of Science" (M.S.) degrees offered by the same institutions. These professional degrees were typically offered in all (or almost all) of the engineering disciplines in which B.S. degrees were offered. They typically involved no research or thesis, and were largely full-time residential programs directed to engineers with some work experience. Most involved a "project," while others were "course work-only." In many cases, this education was paid for by employers, and was regarded as a "benefit" by the employee. At some schools, the number of students in professional degree programs exceeded the number of M.S. students.

In the years following World War II these programs started to become less popular. At the best U.S. engineering schools a combination of reasons led to their gradual elimination. First, federal support for engineering research at U.S. universities grew rapidly after the war, reducing the incentive for colleges of engineering and their faculty to offer these programs. Second, changes in corporate culture resulted in a strong preference for part-time, nonresidential, graduate education. It became much more attractive for large companies to offer tuition reimbursement and slightly reduced working hours or "flex-time" for employees seeking graduate education, rather than to pay a full (or even somewhat reduced) salary to an employee who was not working at all. To accommodate these trends, engineering schools near major employers offered significant numbers of graduate courses in the late afternoon and early evening, which over time increasingly led to the award of non-thesis M.S. degrees.

By the end of the 20th century only a few major engineering schools retained professional master’s degree programs, and it is instructive to discuss those programs before proceeding. They were (and are) at Cornell, Stanford, and MIT.

The professional master's programs at Cornell (with the title "Master of Engineering") are offered in 15 areas (including a few in which Cornell offers no other degree). These programs are one-year residential programs, and involve course work and a significant project, frequently design-oriented. Most of the students come directly from undergraduate school, with the remainder typically being industrial employees whose education is paid for by their employer. Tuition costs are about $37,000/year. In many cases, specialized programs (e.g., "Medical and Industrial Biotechnology") with significant structure have been developed.

At Stanford, all M.S. programs are course work-only and are considered “terminal” degrees in the sense that formal research preparation is not provided via a thesis component. Essentially all of the students admitted directly from undergraduate school are supported by fellowships (from the U.S. government or Stanford funds) and will continue on into the Ph.D., program. Almost all of the other students are industrial employees for whom the employer is paying "full freight," and are terminal M.S. students. To quote the Stanford Web site, "The Masters program is designed principally for students who wish to enter industry as practicing professionals." The Ph.D. degree is considered the degree appropriate for students who desire a career in research. To be considered for admission to some Ph.D. programs, students are expected to secure faculty supervision of a research project.

The "David H. Koch School of Chemical Engineering Practice" operated at MIT has, since 1916, offered a unique graduate education in chemical engineering, with a major component (now one semester) being on-site experience at one or more of industrial "practice stations" staffed by MIT personnel at industrial facilities. It offers a "Master of Science in Chemical Engineering Practice." Students from this program have always been in high demand, and typically command starting salaries higher than those of MIT's M.S.Ch.E. graduates

During the last ten years or so, a number of universities have started (or restarted) professional master's degree programs in engineering. At major engineering schools, the majority are "niche" programs (e.g., MIT's "Master of Engineering in Manufacturing.") Here, we focus on programs at several leading universities, which are particularly pertinent to this proposal.

University of Michigan: Several years ago, Michigan launched a “ Master of Engineering in Energy Systems (MEESE) program (http://energysystemseng.engin.umich.edu). The MEESE program, involves course work and "a significant and industrially relevant team project with industry or government participation." This program is administered through the Michigan Memorial Phoenix Research Institute, a major organized research unit of the University of Michigan.

Currently, the MEESE program has three focus areas: "Civil Power," "Transportation Power," and ""Microelectric and Portable Power." The program requires 24 hours of graded technical course work, in addition to a three-hour seminar course and three hours of project credit. For 30 hours, tuition is $40,230 for Michigan residents, and $44,070 for others. The MEESE program is closely related to the major thrust in energy storage and conversion at Michigan), and it is clear that industry-sponsored projects play a significant role in the program.

Cornell University: Along with its traditional offering of departmentally-oriented Master of Engineering programs, Cornell has since 2006 offered a Masters of Engineering degree with a specialization in "Energy Economics and Engineering" through its School of Chemical and Biomolecular Engineering. More recently, a focus area for a Masters of Engineering degree, entitled "Energy and Sustainability," has been introduced. Both of these programs involve 30 hours of credit, including a significant industry-oriented project.

BUDGETARY AND STAFF IMPLICATIONS:

a) *Additional staff and dollars needed*: NPRE is committed to providing teaching release time or summer salary in the year prior to the implementation of this concentration for the development of the two new courses required: These courses are proposed as ENG

572—Energy Systems Practicum and ENG 573—Energy Engineering Project. Refer to Appendix B—Course Requirements for full description. Students in this concentration will primarily be self-supporting. The CoE has developed a tuition distribution model for departments offering concentrations within M.Eng. Tuition funds returned to the sponsoring department will be used to cover the costs of developing required courses. Following the development of these courses, one faculty member from NPRE will be designated as lead instructor for ENG 572 and a list of NPRE (or NPRE-affiliated) faculty will be designated as available to administer projects initiated under ENG 573.

b) *Internal reallocations (e.g., change in class size, teaching loads, student-faculty ratio, etc.):* The projected enrollment in the Energy Systems Concentration is expected to be small, initially growing to 20-30 students after 4 years. This estimate is based on the number of students already taking courses in energy systems across disciplinary lines. The curriculum for the Energy Systems Concentration will build on the one developed to support the Graduate Option in Energy and Sustainability Engineering (EaSE, as described at http://ease.illinois.edu/). The EaSE option requires the same core courses, ENG 471—Seminar Energy & Sustain Engrg and ENG 571—Theory Energy & Sustain Engrg. The Fall 2010 enrollment for these courses, 50 out of a section size of 100 for ENG 471and 23 out of a section size of 50 for ENG 571, will permit space for the additional students projected for the Energy Systems Concentration. The remaining credit hours in the concentration are allocated among an extensive list of courses from the CoE and other units (see Appendix B—Course Requirements). The projected enrollment is not expected to significantly impact other CoE course enrollments. Graduate tuition dollars returned to the CoE from the Office of the Provost Budget and Resource Planning will be distributed to NPRE to fund additional instructional resources (if any) needed to support curriculum in the Energy Systems Concentration. The CoE has developed a tuition distribution model for departments offering majors and/or concentrations within M.Eng. degree programs. Tuition funds returned to departments will be used to cover the costs of providing additional resources to support faculty in teaching courses with increased enrollment.

c) *Effect on course enrollment in other units and explanations of discussions with representatives of those departments:* With the expected number of students spread through courses widely distributed across the campus, it is not anticipated that additional course sections will be needed to accommodate the students in this concentration. More than half of the 32 hours required for the concentration are allocated among CoE rubrics and any additional resources required to support student enrollment would be funded by tuition distribution to participating departments. The remaining hours of the concentration are outlined in a very flexible framework among an extensive list of courses. This provides the students working with their advisors ample opportunity to select courses that have open enrollment/availability.

d) *Impact on the University Library:* No additional impact on the University Library is anticipated due to this proposal. **Letter Attached**

e) *Impact on computer use, laboratory use, equipment, etc.:* No additional impact on computer use, laboratory use, or equipment is expected due to this proposal.

SUPPLEMENTARY ADMISSIONS INFORMATION:

One of the advantages of this proposed program is that it will open up an opportunity for University of Illinois undergraduates to plan a well-integrated undergraduate major and Master of Engineering degree curriculum. This program may be very attractive to students from Illinois and other institutions with majors in chemistry, biological sciences, physics, geology, mathematics and other non-engineering technical areas. The program is designed to accommodate qualified, motivated, and adequately prepared students from such disciplines. Interested Illinois undergraduate students may apply for provisional admission during the term they will be completing 120 credit hours; providing they have a required minimum 3.25 GPA and have completed at least two hours of NPRE 201—Energy Systems. Such students will be assigned a program advisor and will be required to submit a course sequence plan consistent with completing the program within the equivalent of three full terms for a total of no more than 170 combined undergraduate and graduate credit hours. A faculty member will be assigned to monitor the advising and admissions process, with the assistance of the program committee as needed. Upon successful completion of the B.S. degree and an overall GPA of at least 3.0, students will be fully admitted as graduate students.

DESIRED EFFECTIVE DATE: Fall, 2013

STATEMENT FOR PROGRAMS OF STUDY CATALOG: See Appendix A

CLEARANCES:

Signatures:

Unit Representative:	3 Dec 2010 Date:
College Representative:	3/7/11 Date:
Graduate College Representative:	10/23/12 Date:
Provost Representative:	Date:
Educational Policy Committee Representative:	Date:

APPENDIX A
STATEMENT FOR PROGRAMS OF STUDY CATALOG

College of Engineering

engineering.illinois.edu

Victoria Coverstone
Associate Dean for Graduate and Professional Programs
402 Engineering Hall
1308 West Green Street
Urbana, Illinois 61801
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Major: Engineering
Degrees Offered: M.Eng.
Graduate Concentration: Energy Systems

Graduate Degree Programs

The College of Engineering offers a professional master's degree program for students whose primary intent is a career in industry or government. This degree differs from the Master of Science degree in that it is a terminal degree and not a pathway to a doctoral program. The major in Engineering for the M.Eng. degree requires the selection of an interdisciplinary concentration.

Admission

Students with bachelor's or master's 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. Full details of admission requirements are on the Web page of the department offering the concentration. Currently a Concentration in Energy Systems is offered by the department of Nuclear, Plasma and Radiological Engineering.

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 M.Eng. are above the minimum scores demonstrating an acceptable level of English language proficiency.

Degree Requirements

*For additional details and requirements, please refer to the Web page of the concentration's home unit and the Graduate College Handbook.

Master of Engineering, Major in Engineering with a Concentration in Energy Systems

<table>
<tr><th colspan="2">Requirements</th></tr>
<tr><td>Credit Hours</td><td>Hours</td></tr>
<tr><td>Total Credit for the Degree</td><td>32</td></tr>
<tr><td>Course Work</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):
• Practicum: ENG 572 as approved by an advisor
• Project: ENG 573 as approved by an advisor
• 4 credit hours of course work approved by an advisor from the Topical Breadth list or or other advisor approved course meeting the requirements for Professional Development.</td><td>4</td></tr>
<tr><td>Primary Field courses from an approved list</td><td>12</td></tr>
<tr><td>Secondary Field courses from an approved list</td><td>6</td></tr>
<tr><td>Topical Breadth course from approved list</td><td>3</td></tr>
<tr><td>Electives courses – chosen in consultation with an advisor</td><td>3</td></tr>
<tr><td colspan="2">Other Requirements and Conditions (may overlap):*</td></tr>
<tr><td colspan="2">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 Elective course work requirement.</td></tr>
<tr><td colspan="2">A minimum of 16 500-level credit hours applied toward the concentration, 8 of which must be in ENG or courses in the primary field</td></tr>
<tr><td colspan="2">A maximum of one 1-credit-hour course may be applied toward the minimum 16 500-level credit-hour requirement.</td></tr>
<tr><td colspan="2">The minimum program GPA is 3.0.</td></tr>
</table>

APPENDIX B: Course Requirements

The Energy Systems Concentration requires a total of 32 hours of graduate credit, consisting of courses in core material, a primary field area, a secondary field, 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 Energy & Sustain Engrg (1 hour)
ENG 571—Theory Energy & Sustain Engrg (3 hours)

II. PRIMARY FIELD
At least three courses for at least 12 hours of credit from an approved course list. Refer to Appendix B-II Primary Field.

III. SECONDARY FIELD
At least two courses for at least 6 hours of credit from an approved course list. Refer to Appendix B-III Secondary Field.

IV. PRACTICUM OR PROJECT (Professional Development)
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 from the Topical Breadth course list or other advisor approved course meeting the requirements for Professional Development.

ENG 572—Energy Systems Practicum

ENG 572—Energy Systems Practicum (with variable credit of 4 to 8 credit hours) 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 will require faculty time for a half-day orientation session and a half-day debriefing session. It will also require review of periodic reports, a Web site, and a thesis-length cumulative report. Aside from the orientation and debriefing session, the supervision required will be comparable to that for any master's thesis.

ENG 573—Energy Systems Project

ENG 573—Energy Systems Project (with variable credit of 4 to 8 credit hours) provides a graduate-level project experience. Students will consult with a faculty member from a designated list administered by the program committee, 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 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. TOPICAL BREADTH

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 an approved list.

VI. ELECTIVES

Up to 3 credit hours of course work qualified for graduate credit from approved list of courses (not used to fulfill other requirements) or graduate level courses taken as prerequisite for required courses. Additional practicum or project hours (exceeding the 4 credit hour requirement) may be applied toward this requirement.

B-II: Primary Field

<u>Electric Power Transmission, Distribution, and Conversion</u>
ECE 430—Power Ckts & Electromechanics
ECE 431—Electric Machinery
ECE 432—Advanced Electric Machinery
ECE 450—Lines, Fields, and Waves
ECE 464—Power Electronics
ECE 476—Power System Analysis
ECE 530—Large-Scale System Analysis
ECE 568—Model & Cntrl Electromech Syst
ECE 573—Power System Control
ECE 576—Power System Dynm & Stability
ECE 588—Electricity Resource Planning
ECE 598—Special Topics in ECE, when the topic is Advanced Power Electronics
MSE 460—Electronic Materials I
NPRE 525—Nucl-Electr Energy Conversion

<u>Nuclear Power Generation</u>
AE 412—Viscous Flow & Heat Transfer
ME 412—Numerical Thermo-Fluid Mechs
NPRE 412—Nuclear Power Econ & Fuel Mgmt
NPRE 421—Plasma and Fusion Science
NPRE 431—Materials in Nuclear Eng
NPRE 441—Radiation Protection
NPRE 442—Radioactive Waste Management
NPRE 446—Radiation Interact w/Matter I
NPRE 447—Radiation Interact w/Matter II
NPRE 448—Nuclear Syst Eng & Design
NPRE 455—Neutron Diffusion & Transport
NPRE 457—Safety Anlys Nucl Reactor Syst
NPRE 501—Fundamentals of Nuclear Eng
NPRE 511—Nuclear Reactor Heat Transfer
NPRE 521—Interact of Radiation w/Matter
NPRE 522—Controlled Fusion Systems
NPRE 525—Nucl-Electr Energy Conversion
NPRE 531—Nuclear Materials
NPRE 555—Reactor Theory I
NPRE 556—Reactor Theory II
NPRE 560—Reactor Kinetics and Dynamics

<u>Fuels and Combustion</u>
(At least one course must be either ME 501 or 503.)
ABE 436—Renewable Energy Systems
CEE 445—Air Quality Modeling
CEE 446—Air Quality Engineering
CEE 447—Atmospheric Chemistry
CEE 545—Aerosol Sampling and Analysis
CEE 546—Air Quality Control
GEOL 540—Petroleum Geology
ME 400—Energy Conversion Systems

ME 403—Internal Combustion Engines
ME 501—Combustion Fundamentals
ME 503—Design of IC Engines
ME 598—Special Topics, when the topic is Automotive Bioenergy
NPRE 470—Fuel Cells & Hydrogen Sources

Energy in Building Systems
(At least one course must be either ARCH 441, 480, or 580.)
ABE 476—Indoor Air Quality Engineering
ARCH 441—Heat and Moisture in Buildings
ARCH 544—Bldg Sys & Design Integration
ARCH 576—Architectural Design Seminar, when the topic is Climate Responsive Building Skins or High-Performance Building
ARCH 580—Adv Sustainability Principles
ARCH 594—Spec Prob Building Sci & Tech, when the section is Building Mechanical Systems or Building Energy Simulation
CEE 436—Sustainable Urban Bldg Sites
ME 400—Energy Conversion Systems
ME 401—Refrigeration and Cryogenics
ME 402—Design of Thermal Systems
ME 502—Thermal Systems

Electrochemical Energy Conversion
(At least one course must be either CHBE 453, CHEM 524, or NPRE 470.)
BIOP 432—Photosynthesis
CHBE 424—Chemical Reaction Engineering
CHBE 431—Process Design
CHBE 452—Chemical Kinetics & Catalysis
CHBE 453—Electrochemical Engineering
CHBE 551—Chemical Kinetics & Catalysis
CHEM 460—Green Chemistry
CHEM 524—Electrochemical Methods
ME 400—Energy Conversion Systems
MSE 401—Thermodynamics of Materials
MSE 582—Surface Physics
NPRE 470—Fuel Cells & Hydrogen Sources

Solar Energy
ATMS 510—Precipitation Physics
ATMS 511—Atmospheric Radiation
ATMS 512—Clouds and Climate
BIOP 432—Photosynthesis
ME 522—Thermal Radiation
MSE 401—Thermodynamics of Materials
MSE 487—Materials for Nanotechnology
MSE 488—Optical Materials
MSE 498—Special Topics, when the topic is Photosynthetic Materials and Devices
PHYS 402—Light
PHYS 427—Thermal and Statistical Physics
PHYS 460—Condensed Matter Physics
PHYS 560—Condensed Matter Physics I

Wind Energy
(At least one course must be either AE 481 or NPRE 475)
AE 410—Computational Aerodynamics
AE 416—Applied Aerodynamics
AE 451—Aeroelasticity
AE 481—Wind Power Technology
AE 514—Boundary Layer Theory
AE 515—Wing Theory
AE 525—Advanced Composite Materials
AE 526—Composites Manufacturing
CEE 460—Steel Structures I
CEE 575—Fracture and Fatigue
ME 411—Viscous Flow & Heat Transfer
NPRE 475—Wind Power Systems
TAM 428—Mechanics of Composites
TAM 531—Inviscid Flow
TAM 532—Viscous Flow
TAM 538—Turbulence
TAM 570—Computational Fluid Mechanics

Materials and Design for Thermal Efficiency
(At least one course must be either ME 401, 402, or 502, and a second course must be ME 411, 420, 520, 521, or 522.
CHBE 421—Momentum and Heat Transfer
CHBE 451—Transport Phenomena
CHBE 523—Heat and Mass Transfer
ME 400—Energy Conversion Systems
ME 401—Refrigeration and Cryogenics
ME 402—Design of Thermal Systems
ME 404—Intermediate Thermodynamics
ME 411—Viscous Flow & Heat Transfer
ME 420—Intermediate Heat Transfer
ME 472—Introduction to Tribology
ME 502—Thermal Systems
ME 504—Multiphase Systems & Processes
ME 520—Heat Conduction
ME 521—Convective Heat Transfer
ME 522—Thermal Radiation
MSE 401—Thermodynamics of Materials
MSE 488—Optical Materials

Environmental Engineering for Energy Applications
(At least two courses must be chosen from the CEE courses shown.)
ABE 436—Renewable Energy Systems
ATMS 421—Earth Systems Modeling
ATMS 447—Climate Change Assessment
ATMS 448—Climate and Climate Change
ATMS 449—Biogeochemical Cycles
ATMS 511—Atmospheric Radiation
ATMS 512—Clouds and Climate

CEE 434—Environmental Systems I
CEE 442—Env Eng Principles, Physical
CEE 443—EnvEng Principles, Chemical
CEE 445—Air Quality Modeling
CEE 446—Air Quality Engineering
CEE 447—Atmospheric Chemistry
CEE 545—Aerosol Sampling and Analysis
CHLH 461—Environmental Toxicology
CHLH 469—Environmental Health
CPSC 431—Plants and Global Change

B-III. Secondary Field

Biomass Energy Resources
This secondary field focuses knowledge and skills pertinent to biomass energy resources. It provides students with a perspective of biomass as an energy source compared to other energy sources. Students can take specialization courses that address the production and processing of biomass into energy as well as analyzing biomass energy systems with respect to their workability and sustainability. The analysis emphasizes life cycle analysis and environmental impacts.

Biomass
ABE 488—Bioprocessing Grains for Fuels
ABE 498—Special Topics; qualifies for this secondary field when taken for at least 3 credit hours and the topic is Processing of Biomass, Biomass Production Engineering, Analysis of Bioproduction Systems for Workability and Sustainability; Integrated Water Reuse for Agricultural, Municipal and Energy Systems, or another advisor-approved topic. Two approved courses of ABE 498 on different topics may be combined to fulfill secondary field requirements.

Bioenergy
ACE 435—Global Agribusiness Management
ACE 442—Modeling App in Agr Finance
ACE 443—Inter Agricultural Finance
ACE 455—Intl Trade in Food and Agr
ACE 551—International Food Policy I
ACES 409—Bioenergy Systems
ACES 501—Advanced Bioenergy Topics
ACES 509—Advanced Bioenergy Systems
ECON 500—General Microeconomic Theory

Geologic Energy Resources
This secondary field is concerned with the location and extraction of energy resources and their transport to energy conversion facilities such as electrical power plants and refineries.

Petroleum Geology
GEOL 440—Sedimentology and Stratigraphy
GEOL 411—Structural Geol and Tectonic
GEOL 540—Petroleum Geology

Geochemistry
GEOL 560—Physical Geochemistry
GEOL 562—Isotope Geology

GEOL 563—Analytical Geochemistry

Pipeline Flows
TAM 532—Viscous Flow
TAM 435—Intermediate Fluid Mechanics

Pipeline Structures
AE 529—Viscoelasticity Theory
TAM 424—Mechanics of Structural Materials
TAM 428—Mechanics of Composites

Pipeline Networks
GEOG 479—Advanced Geog Info Systems
GEOG 489—Programming for GIS
GEOG 505—Seminar in Physical Geography (taken for at least three credit hours)
ME 450—Modeling Materials Processing
ME 551—Polymer Rheology & Processing

<u>Energy Markets</u>
The availability and widespread use of energy sources is intimately tied to energy demand, future projections, and the economic competition between available sources. This secondary field supplies the student with quantitative methods by which a portfolio of energy sources can be optimized.

Engineering and Markets
GE 498—Special Topics*; qualifies for this secondary field when taken for at least 3 credit hours and the topic is Introduction to Financial Engineering, An Entrepreneurial Approach to Green Engineering, or another advisor-approved topic.
GE 530—Multiattribute Decision Making
ECE 588—Electricity Resource Planning
ECON 501—Quantitative Analysis for Econ

Econometrics
ECON 506—Economic Statistics
ECON 507—Econometric Analysis

Resource Economics Modeling
ACE 562—Applied Regression Models I (2 credit hours)
ACE 564—Applied Regression Models II (2 credit hours)
ACE 565—Modeling Dynamic Econ Systems (2 credit hours)

Microeconomics
ECON 500—General Microeconomic Theory
ECON 502—Microeconomic Theory I
ECON 504—Microeconomic Theory II

International Economics
ECON 420—International Economics (must be taken for 4 credit hours)
ECON 520—International Trade Theory
ECON 550—Econ of Development and Growth Environmental Economics

ACE 411—Environment and Development
ACE 510—Adv Natural Resource Economics
ECON 516—Environmental Economics

Energy Safety and Security

The safety and security of energy supplies is of paramount importance. This secondary field includes course work relevant to safety or security.

Safety
IE 442—Safety Engineering
IE 540—Design of Man-Machine Systems
GE 411—Reliability Engineering
GE 524—Data-Based Systems Modeling
NPRE 441—Radiation Protection
NPRE 442—Radioactive Waste Management
NPRE 457—Safety Anlys Nucl Reactor Syst
ENVS 469—Environmental Health
ENVS 540—Public Involvement in Res Mgmt

Security
NPRE 480—Energy and Security
NPRE 481—Writing on Technol & Security
NPRE 483—Seminar on Security
CS 438—Communication Networks
CS 465—User Interface Design
CS 565—Human-Computer Interaction
CS 461—Computer Security I
CS 463—Computer Security II

Water and Land

This secondary field focuses on the water and land context in which energy systems operate.

Hydrologic Science & Water Resources Engineering
CEE 450—Surface Hydrology
CEE 451—Environmental Fluid Mechanics
CEE 453—Urban Hydrology and Hydraulics
CEE 550—Hydroclimatology
CEE 551—Open Channel Flow
CEE 552—River Basin Management
CEE 555—Mixing in Environmental Flows
ABE 456—Land & Water Resources Engrg
ABE 459—Drainage and Water Management

Water Quality Science and Engineering
CEE 442—Env Eng Principles, Physical
CEE 443—Env Eng Principles, Chemical
CEE 449—Environmental Engineering Lab
CEE 534—Surface Water Quality Modeling
CEE 457—Groundwater
CEE 557—Groundwater Modeling

Hydrogeology
GEOL 470—Introduction to Hydrogeology
GEOL 570—Hydrogeology

Geothermal Fluids
GEOL 570—Hydrogeology
GEOL 470—Introduction to Hydrogeology

Dams
CEE 581—Earth Dams
CEE 484—Applied Soil Mechanics
CEE 483—Soil Mechanics and Behavior

Surface Water
CEE 550—Hydroclimatology
CEE 450—Surface Hydrology
GEOL 406—Fluvial Geomorphology

Management, Human Environments
CEE 434—Environmental Systems I
CEE 440—Solid & Hazardous Waste
CEE 535—Environmental Systems II
RST 444—Social Impact Assessment
LA 550—Environ. Impact Assessment
GEOG 466—Environmental Policy
LA 450—Ecology for Land Restoration
UP 446—Sustainable Planning Seminar (formerly ARCH 580)
UP 547—Growth Mgmt and Regional Plng
UP 494—Special Topics in Planning*; qualifies for this secondary field when taken for at least 3 credit hours and the topic is Sustainable Site Planning

B-IV. Topical Breadth

ACE 406—Environmental Law
ACE 411—Environment and Development
ACE 448—Rural Real Estate Appraisal
ACE 453—Econ Dev in S and SE Asia
ACE 454—Econ Dev of Tropical Africa
ACE 471—Consumer Economic Policy
ACE 474—Econ of Consumption
ACE 500—Applied Economic Theory
ACE 501—Risk and Info: Theory and App
ACE 510—Adv Natural Resource Economics
ACE 516—Environmental Economics
ACE 527—Advanced Price Analysis
ACE 530—Applied Production Economics
ACE 553—Topics in Regional Development
ACE 555—Economic Impact Analysis
ANTH 467—Cultures of Africa
ANTH 504—Colonialism & Postcolonialism
ANTH 505—Global Modernities

ARCH 534—Building Economics
ARCH 538—Econ Issues in Arch Development
ATMS 420—Atmospheric Chemistry
ATMS 421—Earth Systems Modeling
ATMS 425—Air Quality Modeling
ATMS 447—Climate Change Assessment
ATMS 448—Climate and Climate Change
ATMS 449—Biogeochemical Cycles
ATMS 511—Atmospheric Radiation
ATMS 512—Clouds and Climate
ATMS 530—Global Atmospheric Modeling
BIOP 432—Photosynthesis
CHEM 440—Physical Chemistry Principles
CHEM 442—Physical Chemistry I
CHEM 460—Green Chemistry
CHEM 524—Electrochemical Methods
CHEM 544—Statistical Thermodynamics
CHLH 461—Environmental Toxicology
CHLH 469—Environmental Health
CPSC 431—Plants and Global Change
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—Govt Reg of Economic Activity
ECON 483—Econ of Innovation and Tech
ECON 484—Law and Economics
ECON 500—General Microeconomic Theory
ECON 501—Quantitative Analysis for Econ
ECON 502—Microeconomic Theory I
ECON 503—Macroeconomic Theory I
ECON 504—Microeconomic Theory II
ECON 505—Macroeconomic Theory II
ECON 509—General Macroeconomic Theory
ECON 516—Environmental Economics
ECON 517—Political Economy
ECON 520—International Trade Theory
ECON 521—Topics in International Econ
ECON 523—Business International Econ
ECON 531—American Economic History
ECON 550—Econ of Development and Growth
ECON 581—Govt Regulation of Industry
ENVS 444—Social Impact Assessment
ESES 466—Environmental Policy
ESES 482—Challenges of Sustainability
GEOG 455—Geog of Sub-Saharn Africa
GEOG 465—Trans Systems and Spatial Dev
GEOG 466—Environmental Policy
GEOG 467—Dynm Simul of Nat Res Problems
GEOG 520—Political Ecology

GEOL 540—Petroleum Geology
GLBL 482—Miltry & Civ Uses of Nucl Energy
HIST 437—Middle East in 20th Century
IB 452—Ecosystem Ecology
NRES 410—Applied Natural Resource Econ
NRES 427—Modeling Natural Resources
NRES 439—Env and Sustainable Dev
NRES 508—Community & Natural Resources
NRES 540—Public Involvement in Res Mgmt
PS 457—Dem Gov in a Global Setting
PS 480—Energy and Security
PS 503—US Congress
PS 504—US Presidency
PS 505—Law and Politics
PS 507—Collect Action & Interest Grps
PS 543—Global Democratization
PS 544—Politics of African States
PS 582—Intl Political Economy
RSOC 443—Social Change in Dev Areas
SOC 427—Latin Amer Social Pol Inst
SOC 447—Environmental Sociology
SOC 457—Sociology of Technology
TE 565—Technol Innovation & Strategy
UP 408—Law and Planning
UP 430—Urban Transportation Planning
UP 441—Land Resource Evaluation
UP 442—Environmental Policy and Law
UP 552—Regional Development Theory

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

University Library
Office of Dean of Libraries
and University Librarian
230 Main Library, MC-522
1408 West Gregory Drive
Urbana, IL 61801

November 5, 2012

Victoria L. Coverstone
Associate Dean, Office of Graduate and Professional Programs
College of Engineering
401 Engineering Hall
MC-266

Dear Professor Coverstone:

Thank you for providing the University Library with the opportunity to review the College of Engineering's proposal to the Senate Committee on Educational Policy to establish a Master of Engineering (M.Eng.), the major in engineering, and the concentration in Energy Systems. Based upon the proposal that we reviewed, we do not believe that there will be any substantive impact on existing library offerings—either in terms of library materials or personnel.

The librarians in the Grainger Engineering Library have an excellent relationship with the College and if additional services or materials are required as the program develops, I have every confidence that we will be able to work together to meet the needs of the students.

Sincerely,

Paula T. Kaufman
Juanita J. and Robert E. Simpson
Dean of Libraries and University Librarian

c: Thomas Teper
William Mischo
Elizabeth Stovall, Graduate Programs Director, CoE

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Senate Educational Policy Committee
Proposal Check Sheet

PROPOSAL TITLE (Same as on proposal): Establish a Graduate Concentration in Energy Systems within the Major in Engineering in the Master of Engineering Degree in the College of Engineering

PROPOSAL TYPE (select all that apply below)**:**

A. ☒ Proposal for a NEW or REVISED degree program. Please consult the Programs of Study Catalog for official titles of existing degree programs.

1. Degree program level:

   ☒ Graduate ☐ Professional ☐ Undergraduate

2. ☐ Proposal for a new **degree** (e.g. B.S., M.A. or Ph.D.):

   Degree name, "*e.g., Bachelor of Arts or Master of Science*": _____

3. ☐ Proposal for a new or revised **major, concentration, or minor**:

   ☐ New or ☐ Revised **Major** in (name of existing or proposed major): _____

   ☒ New or ☐ Revised **Concentration** in (name of existing or proposed concentration): Energy Systems

   ☐ New or ☐ Revised **Minor** in (name of existing or proposed minor): _____

4. ☐ Proposal to rename an existing major, concentration, or minor:

   ☐ Major ☐ Concentration ☐ Minor

   Current name: _____

   Proposed new name: _____

5. ☐ Proposal to terminate an existing degree, major, concentration, or minor:

   ☐ Degree ☐ Major ☐ Concentration ☐ Minor

   Name of existing degree, major, or concentration: _____

6. ☐ Proposal involving a multi-institutional degree:

   ☐ New ☐ Revision ☐ Termination

Name of existing Illinois (UIUC) degree: _____

Name of non-Illinois partnering institution: _____

Location of non-Illinois partnering institution:

☐ State of Illinois ☐ US State: _____ ☐ Foreign country: _____

B. ☐ Proposal to create a new academic unit (college, school, department, program or other academic unit):

Name of proposed new unit: _____

C. ☐ Proposal to rename an existing academic unit (college, school, department, or other academic unit):

Current name of unit: _____

Proposed new name of unit: _____

D. ☐ Proposal to reorganize existing units (colleges, schools, departments, or program):

1. ☐ Proposal to change the status of an existing and approved unit (e.g. change from a program to department)

   Name of current unit including status: _____

2. ☐ Proposal to transfer an existing unit:

   Current unit's name and home: _____

   Proposed new home for the unit: _____

3. ☐ Proposal to merge two or more existing units (e.g., merge department A with department B):

   Name and college of unit one to be merged: _____

   Name and college of unit two to be merged: _____

   Proposed name and college of new (merged) unit: _____

4. ☐ Proposal to terminate an existing unit:

   Current unit's name and status: _____

E. ☐ **Other educational policy proposals** (e.g., academic calendar, grading policies, etc.)

Nature of the proposal: _____

Revised 10/2012

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

EP.13.12

Office of the Provost and Vice Chancellor
for Academic Affairs
Swanlund Administration Building
601 East John Street
Champaign, IL 61820

October 25, 2012

Gay Miller, Chair
Senate Committee on Educational Policy
Office of the Senate
228 English Building, MC-461

Dear Professor Miller:

Enclosed is a copy of a proposal from the Graduate College and the College of Engineering to establish a graduate concentration in Energy Systems in the Master of Engineering (M. Eng) in Engineering.

This proposal has been approved by the Graduate College Executive Committee and the College of Engineering Executive Committee. It now requires Senate review.

Sincerely,

Kristi A Kuntz

Kristi A. Kuntz
Assistant Provost

KAK/njh

Enclosures

c: M. Bragg
W. Buttlar
V. Coverstone
C. Singer
E. Stovall
J. Stubbins

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Graduate College

204 Coble Hall
801 South Wright Street
Champaign, IL 61820-6210

October 23, 2012

Kristi Kuntz
Office of the Provost
207 Swanlund MC-304

Dear Kristi,

Enclosed are the two proposals entitled "Establish a Major in Engineering in the College of Engineering for the degree of Master of Engineering" and "Establish a Graduate Concentration in Energy Systems within the Master of Engineering Degree in the College of Engineering." The Graduate College Executive Committee has approved both of these proposals. I send them to you now for further review.

Sincerely,

William G. Buttlar
Associate Dean, Graduate College

c: M. Bragg
V. Coverstone
M. Lowry
C. Singer
E. Stovall
J. Stubbins