

**Proposal for a Master of Engineering in
Energy Systems Engineering
Fall, 2013**

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Request for a New Master Degree Program
College of Engineering, Iowa State University
Master of Engineering in Energy Systems Engineering

1. Describe the proposed new degree program including the following:

a. Brief description of the program and Statement of academic objectives.

One of the challenges facing society in the 21st century is providing sustainable energy for a growing world population. Widely reported warnings have emphasized the need to develop new sources of energy, at the same time a preventing or reversing the degradation of the environment.¹ Energy systems are pervasive, affecting nearly every aspect of society. The increasing complexity of these systems, along with increasing environmental constraints, requires practicing professionals in the field that have knowledge, skills, and abilities specific to energy system design, evaluation, construction, and management.

The Master of Engineering in Energy Systems Engineering is an interdepartmental degree program that addresses these challenges. The program provides a foundation in Energy Systems Engineering and Analysis, and Energy Economics and Policy. Students take additional courses in a variety of energy systems. They must take at least three elective courses in a single focus area: biorenewables, wind, nuclear, power generation and distribution, building energy and energy efficiency, or thermal science.

This degree program will be offered to online (“distance”) students. The two required courses are offered online along with over half of the elective courses.

The academic objective of this new degree is to prepare graduates to be able to design, evaluate, build, and manage complex energy systems. The program will prepare professionals to utilize methodologies for physical and economic assessment of current and future energy needs, applying them in industry, research, and education.

b. The relationship of the proposed new program to the institutional mission and how the program fits into the institution’s and college’s strategic plan.

The College of Engineering strategic plan focuses on grand challenges and builds upon our core competencies, which include energy related areas and new curricula (<http://www.engineering.iastate.edu/strategic-plan/strategy/>). Iowa State University has embraced this concept, and elements of the grand challenges are integral in the University’s 2010-2015 Strategic Plan (<http://www.provost.iastate.edu/sp/>). A common theme in the grand challenges and ISU’s strategic plan is energy and how renewable and sustainable energy systems are critical for the future of our nation. In all cases, this proposed major will help the University and College meets its strategic objectives.

To address the energy challenges of the future, we must educate students of today in the area of energy and energy systems. The State of Iowa has recognized this need and approached Iowa State with a request to develop educational content in energy and energy systems. As a result of this request, the leaders in this effort submitted a proposal to the Iowa Office of Energy Independence (OEI) which was subsequently funded. Part

¹ National Academy of Engineering, 2008. Grand Challenges for Engineering.
<http://www.engineeringchallenges.org/File.aspx?id=11574>, accessed 9/02/2011, p. 2.

of this project is to develop a graduate program in energy systems to help educate Iowans and others in this vital area. Please see the appendix for a copy of the OEI contract.

The Board of Regents, Iowa State and the College of Engineering all have a strategic goal of increasing access to education via distance education. This degree will be available to students and practicing professionals online. The degree can be completed 100% online if the student so chooses and selects courses appropriately. It complements and adds to the nine (9) online graduate degrees currently offered by the College of Engineering.

c. The relationship of the proposed new program to other existing programs at the institution; describe how the proposed program will enhance other programs at the university.

Currently there is no Energy Systems Engineering program for graduate level study at Iowa State University. College of Engineering departments offer a graduate degree in their own disciplines. This degree program will provide College-wide, integrated coursework, with a focus on new and evolving Energy Systems Engineering technology.

New and revised courses are being developed specifically to address the growing need for education and understanding of Energy Systems. These courses, plus many existing courses, will form the framework of an interdepartmental effort to enhance student knowledge of Energy Systems Engineering and its application to business, industry and the individual.

d. The relationship of the proposed new program to existing programs at other colleges and universities in Iowa, including how the proposed program is different or has a different emphasis than the existing programs.

The University of Iowa and University of Northern Iowa do not offer a graduate program in this area. The Energy Systems Engineering Master of Engineering Degree emphasizes a wide and diverse integration of knowledge across all Engineering disciplines.

e. Special features or conditions that make the institution a desirable, unique or appropriate place to initiate such a degree program.

Iowa State University's College of Engineering is well equipped to provide a coursework only Master's Degree, with 226 tenured/tenure track faculty, and additional faculty being added in the coming years. The College has a number of significant energy research programs. It currently teaches numerous energy-related courses at both the graduate and undergraduate level. The College already offers nine graduate degrees and 13 graduate certificates online.

f. Does the proposing institution have personnel, facilities, and equipment adequate to establish and maintain a high quality program?

Yes. Faculty across all College departments will be participating in this program. Our well established Engineering-LAS Online Learning unit has the expertise and capacity to offer this new degree online. Oversight of the Energy Systems Engineering program will be provided by a supervisory committee with support from the Department of Mechanical Engineering.

g. How does student demand for the proposal program justify its development?

Practicing professionals are increasingly engaged in energy systems engineering. There is an unmet need for education and training in this area. We have received numerous inquiries from potential and existing graduate students about energy related coursework. Currently, such students are scattered across a number of other programs in the College. This new degree will provide a focus point for graduate engineering students interested in energy systems, whether on-campus or practicing professionals off-campus.

2. Describe the state and/or national workforce need and/or demand for graduates of the proposed program currently and in the foreseeable future (provide documentation about the sources of data used to estimate need and demand).

We expect the market demand for the Master of Engineering in Energy Systems Engineering, as well as energy-related credit and non-credit courses to grow based on anecdotal evidence from recent student demand and from projections from the U.S. Bureau of Labor and Statistics (BLS). Energy-related jobs are not categorized separately by BLS, but instead are embedded in a number of industry sectors. Growth in demand for energy-related courses and degrees is expected to parallel growth of the following sectors: engineering; management, scientific, and technical consulting; utilities; power plant operators, distributors, and dispatchers; green construction; wind energy; and others.

In 2011, engineers held about 1.6 million jobs and BLS projects employment to grow by 7-13% between 2008 and 2018. The management, scientific, and technical consulting services industry had about 1.0 million jobs and is expected to be one of the fastest growing of all industry sectors over the decade, growing by 83%.

The utility sector was comprised of over 500,000 jobs in 2011. The sector is expected to decline, but job openings are expected due to the large number of employees nearing retirement. Power plant operators, distributors, and dispatchers held about 50,000 jobs. This industry sector is not expected to grow, but job openings are expected to be excellent due to a large number of retirements.

BLS data on green jobs show employment of over 1.9 million in 2011. The U.S. Green Building Council and Booz Allen Hamilton estimate that this sector supported more than 2.4 million jobs in in the past decade and expects this to rise to about 3.3 million jobs by 2013. The American Wind Energy Association estimates that there are currently 85,000 jobs in the wind power industry and related fields. Growth estimates vary, depending in part on the projected availability of the production tax credit.

Additional jobs, and potential demand for this degree, exist in other markets, including bioenergy, solar power, hydropower, and geothermal energy.

3. List all other public and private institutions of higher education in Iowa currently operating programs similar to the proposed new degree program. (For comparison purposes, use a broad definitional framework, e.g. such identification should not be limited to programs with the same title, the same degree designation, having the same curriculum emphasis, or purporting to meet exactly the same needs as the proposed program.)

No other public or private institution of higher education in Iowa is currently offering a program similar to the Master of Engineering in Energy Systems Engineering.

4. Numbers estimates for 7 years out – majors and non-majors separated. – UG and Grad, separated.

a. Undergraduate: not applicable.

b. Graduate:

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Majors	10	20	30	40	50	50	50
Non-majors	0	0	0	0	0	0	0

c. What are the anticipated sources of these students?

Industry professionals seeking advanced knowledge of the new and emerging technologies in energy systems engineering are the primary source of students. Graduate engineering students from Iowa and beyond who want to pursue additional education in energy systems engineering will also be a source. There are similar graduate programs at other engineering schools across the country – we will successfully compete in the same pools from which these schools draw their students.

5. If there are plans to offer the program away from campus, briefly describe these plans including potential sites and possible methods of delivery instruction. Will off-campus delivery require additional HLC accreditation?

On-line delivery of the coursework only Master of Engineering Degree in Energy Systems Engineering will be provided through Engineering-LAS Online Learning. Students may also choose to take courses on campus, or a combination of these two methods. There are no plans to teach courses on off-campus sites, nor will HLC accreditation be required.

6. Has the proposed program been reviewed and approved by the appropriate campus committees and authorities?

Yes.

7. List date the program proposal was submitted to the Iowa Coordinating Counsel for Post High School Education (ICCPHSE) and results of listserv review.

Will be submitting.

8. Will the proposed program apply for programmatic accreditation? When?

No, the program will not apply for accreditation.

9. Will articulation agreements be developed for the proposed program? By whom?

No, there are no articulation agreements.

10. Describe the faculty, facilities, and equipment that will be required for the proposed program.

a. Faculty: Faculty across all disciplines of the College of Engineering at Iowa State University will be involved in the delivery of the courses for the program and serve as advisors to students. Most of these courses are currently being offered to satisfy

discipline-specific needs in the respective departments. The Master of Engineering in Energy Systems Engineering will focus these courses into a single program.

- b. A Director of Graduate Education (DOGE) for the Energy Engineering Systems degree will direct the student’s admission and Program of Study. A supervisory committee will oversee the curriculum.
- c. Mechanical Engineering will be the Home Department for the program, assisting the DOGE with administration of the program.
- d. Facilities include existing classrooms for on-campus course delivery that are also used for synchronous and asynchronous online delivery.
- e. Equipment: No specialized equipment will be required. Existing equipment for online delivery will be utilized.

11. **From where will the financial resources for the proposed program come** (list all that apply, e.g. department reallocation, college reallocation, grants, new to the University)?

SOURCES	TOTAL AMOUNT
Department reallocation, Department of Mechanical Engineering, P/S support staff time.	\$20,000
College reallocation, College of Engineering, P/S support staff time, marketing, advising.	\$30,000
Engineering differential tuition from students	\$592/student

12. **Estimate the total costs/total new costs** (incremental increases in expenditures) that will be necessary for the next seven years as a result of the new program.

	TOTAL COSTS	TOTAL NEW COSTS
Year 1	\$50,000	\$50,000
Year 2	\$50,000	\$50,000
Year 3	\$50,000	\$50,000
Year 4	\$50,000	\$50,000
Year 5	\$50,000	\$50,000
Year 6	\$50,000	\$50,000
Year 7	\$50,000	\$50,000

Supplemental materials

(to be used at Iowa State University in the review of the proposal):

13. Program requirements

Degree requirement	Credits	Description
Required courses (2)	6	<ul style="list-style-type: none"> ME 531X: Advanced Energy Systems and Analysis (3 credits) ME 510X: Energy Engineering Economics and Policy (3 credits)
Math/Statistics (1)	3	Any 500-level or higher Math or Statistics class or a Math or Statistics class labeled “non-major graduate credit” (EXCEPT Math 307 and Math 317).
Professional Development (1)	3	Area of interest that meets the individual educational objectives of the student for professional development from an approved list.
Elective Engineering courses	15	Courses in energy systems engineering from an approved list. Nine credits must be in a single focus area (biorenewables, wind, nuclear, power generation and distribution, building energy and energy efficiency, thermal science or as approved)
Free elective	3	Any class from the above categories.

a. Prerequisites for prospective students.

Bachelors of Science degree in Engineering or Bachelors of Science degree, non-Engineering with:

- 11 semester credits in math (through differential equations)
- 16 semester credits in physics, chemistry and engineering sciences.

b. Language requirements.

None

c. Courses and seminars presently available for credit toward the program.

Math/Statistics requirement

Three (3) credits of any 500-level or higher Math or Statistics class or a Math or Statistics class labeled “non-major graduate credit” (EXCEPT Math 307 and Math 317) will count towards this requirement. Non-Math/Stat courses with strong math or statistics content that are approved by the Master of Engineering – Energy Systems Engineering Steering Committee may also count towards meeting this requirement.

Approved courses for Math/Stat requirement (*=offered online)

- All Statistics Courses 400 and higher labeled non-major graduate credit. Popular courses are:
 - *STAT 401: Statistical Method for Researchers
 - *STAT 495: Applied Statistics for Industry
- All Math courses 300 and higher labeled “non-major graduate credit” EXCEPT Math 307 and 317.

Optimization (linear, nonlinear, and integer programming; global optimization methods)

- *IE 510: Network Analysis

- *IE 534: Linear Programming
- IE 631: Nonlinear Programming
- IE 632: Integer Programming
- Econ 500/600: Quantitative Methods in Economic Analysis I/II
- Econ 509: Applied Numerical Methods in Economics

Modeling and Simulation (physical modeling through differential equations and their solution, computer visualization)

- EM 425: Introduction to Finite Element Methods
- EM 525: Finite Element Analysis
- EM 526: Boundary Element Methods in Engineering
- Phys 480/481: Quantum Mechanics I/II
- Phys 531: Statistical Mechanics
- Phys 564: Advanced Classical Mechanics
- Phys 591/592: Quantum Physics I/II
- *ME 546/547: Computational Fluid Dynamics and Heat Transfer I/II
- *ME 557: Computer Graphics and Geometric Modeling
- ComS 477/577: Problem Solving Techniques for Applied Computer Science
- AerE 647: Advanced High Speed Computational Fluid Dynamics
- AerE 572: Turbulence
- *ChE 545: Analytical and Numerical Methods

Linear and abstract algebra, real and functional analysis

- EM 510: Continuum Mechanics
- *EE 570: Systems Engineering Analysis and Design
- EE 674: Advanced Topics in Systems Engineering
- Phys 534: Symmetry and Group Theory in Physics

Probability and Statistics (outside of statistics department)

- *IE 513: Analysis of Stochastic Systems
- *IE 533: Reliability
- Econ 500: Quantitative Methods in Economic Analysis I
- Econ 509: Applied Numerical Methods in Economics
- Econ 571: Introductory Econometrics
- Econ 671/672: Econometrics I/II

Professional Development requirement

Three (3) credits in an area of interest that meets the individual educational objectives of the student for professional development that is approved by the Master of Engineering – Energy Systems Engineering Steering Committee

Approved courses for Professional Development requirement (*=offered online)

- *ConE 380: Engineering Law
- Econ 355: International Trade and Finance
- *Fin 501: Financial Valuation and Corporate Financial Decisions
- *HCI 594X: Organizational Application of Collaborative Technology
- HG ED 561: College Teaching
- *IE 563 Engineering Management Theory
- *IE 570: Systems Engineering and Project Management
- *ME 584: Technology, Globalization and Culture
- MGMT 570: Managing Employee Attitudes and Behaviors
- MGMT 571: Seminar in Personnel and Human Resources Management
- *MGMT 583: Strategic Management of Innovation

- *MKT 501: Marketing
- *MGMT 503 Professional Responsibility in Business and Society
- SCM 502: Supply Chain Management
- *SCM 524: Strategic Process Analysis and Improvement
- Any foreign language courses labeled "non-major graduate credit" (prerequisites may be needed which will not count towards the requirement)
- Other courses, as approved by the POS committee

Elective Engineering Courses

Fifteen (15) graduate credits in energy systems engineering from an approved list. These courses are determined by the student and academic advisor to fit the needs of the individual student's program. If the student's undergraduate degree did not include a course in thermodynamics, three (3) credits must be ChE 357, MatE 311, or ME 332 or the equivalent.

In order to be included on the approved course list, course content must be at least half "energy related" and available for graduate or non-major graduate credit. Energy related means content significantly covers any of the following in an engineering context:

- (1) energy fundamentals, e.g., thermodynamics, heat transfer;
- (2) energy production, transmission or utilization;
- (3) design of energy production, transmission or utilization systems or components;
- (4) analysis of energy production, transmission or utilization systems or components.

Students must take at least nine (9) credits in a single focus area: biorenewables (B), wind (W), nuclear (N), power generation and distribution (P), building energy and energy efficiency (E), or thermal science (T).

Approved courses for Engineering Electives requirement (*=offered online)

Course	Course Title	Focus Area					
		B	W	N	P	E	T
*AerE 381	Introduction to Wind Energy		X				
AerE 481	Advanced Wind Energy: Technology and Design		X				
*AerE 546	Computational Fluid Dynamics and Heat Transfer I		X			X	X
*AerE 547	Computational Fluid Dynamics and Heat Transfer II		X			X	X
AerE 570	Wind Engineering		X				
AE 363	Agri-Industrial Applications of Electric Power and Electronics				X		
AE 568	Pretreatment of Biomass	X					
BSE 480	Engineering Analysis of Biological Systems	X					
*BRT 501	Fundamentals of Biorenewable Resources	X					
BRT 511	Bioprocessing and Bioproducts	X					
*BRT 535	Thermochemical Processing of Biomass	X					
*ChE 357	Transport Phenomenon II						X
ChE 358	Separations	X					X
ChE 381	Chemical Engineering Thermodynamics						X
*ChE 554	Integrated Transport Phenomenon	X					X
ChE 583	Advanced Thermodynamics	X			X	X	X
CE 511	Bioprocessing and Bioproducts	X					
CE 594S	Building Energy Modeling					X	

ConE 353	Electrical Systems in Buildings						X	
*ConE 354X	Building Energy Systems						X	
EE 448	Introduction to AC Circuits and Motors					X		
*EE 455	Introduction to Energy Distribution Systems					X		
*EE 456	Power System Analysis I					X		
*EE 457	Power System Analysis II					X		
*EE 458	Economic Systems for Electric Power Planning					X		
*EE 553	Steady State Analysis					X		
*EE 554	Power System Dynamics					X		
EE 555	Advanced Energy Distribution Systems					X		
*EE 556	Power Electronic Systems					X		
*EE 653	Advanced Topics in Electric Power Systems Engineering					X		
IE 543X	Wind Energy Manufacturing		X					
*ME 332	Engineering Thermodynamics II					X	X	X
*ME 433	Alternative Energy Conversion	X	X	X	X	X	X	X
ME 436	Heat Transfer						X	X
ME 441	Fundamentals of Heating, Ventilating and Air Conditioning						X	
ME 442	Heating and Air Conditioning Design						X	
ME 444	Elements and Performance of Power Plants				X	X		X
ME 449	Internal Combustion Engine Design					X		X
*ME 530	Advanced Thermodynamics					X	X	X
*ME 540	Solar Energy Systems					X	X	X
*ME 542	Advanced Combustion							X
ME 545	Thermal Systems Design	X	X	X	X	X	X	X
*ME 546	Computational Fluid Mechanics and Heat Transfer I		X				X	X
*ME 547	Computational Fluid Mechanics and Heat Transfer II		X				X	X
*ME 637	Convection Heat Transfer						X	X
ME 638	Radiation Heat Transfer				X		X	X
MatE 311	Thermodynamics in Materials Engineering							X
MatE 463X	Materials for Wind Energy		X					
MSE 520	Thermodynamics and Kinetics of Multicomponent Materials							X
*NucE 401	Nuclear Radiation Theory and Engineering				X			
*NucE 430X	Nuclear Engineering and Society				X			
*NucE 441	Probabilistic Risk Analysis				X			
NucE 461	Radiation Detection, Measurement and Simulation				X			

d. Proposed new or modifications of existing courses.

Two new courses are proposed, both are required of all students in the program.

- ME 531X: Advanced Energy Systems and Analysis (3 credits)
- ME 510X: Energy Engineering Economics and Policy (3 credits)

ME 531X has been approved by the ME Department, the College of Engineering and the Graduate College. ME 510X has been approved by the ME Department and approvals at the College of Engineering and Graduate College are pending.

Several existing courses have been modified for online delivery. All course development is being paid for by energy education grant the College of Engineering received from the Iowa Office of Energy Independence.

e. Thesis and non-thesis options in master's programs.

This is a non-thesis (coursework only) Master degree.

f. Implications for related areas within the university.

Since the program is primarily directed to distance students there will be minimal impact on university services.

g. Admissions standards for graduate programs.

- Minimum of 3.0 undergraduate grade-point average (GPA) – official documentation from previous studies that meets the requirements of the Graduate College. (4.0 scale).
- Official documentation of Graduate Record Exam (GRE) scores. If the undergraduate degree is from a regionally accredited institution, the applicant can request to have this requirement waived.
- International (non-English speaking) students need to take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). Minimum scores for admission are: paper based – 550; computer based – 213; or internet based – 79-80.
- Students with undergraduate degrees from a non-accredited US institution or from a non-US institution are required to submit official documentation of Graduate Record Exam (GRE) scores.

14. Attach to the program proposal memos from the department chair(s), the college dean(s), and other appropriate persons, agreeing to the allocation of new resources and/or the reallocation of resources as described in the Regents questions.

See attached memos from the College of Engineering Dean's office and the Department of Mechanical Engineering.

15. Attach to the program proposal, letters of support, recommendations, and statements when appropriate:

a. From programs at the other Regents universities

Not applicable.

- b. From programs and departments at ISU which are associated with the proposed**
See attached memos from departments within the College of Engineering.
- c. From industrial partners that have an interest in the proposed program**

Governance Document

Master of Engineering in Energy Systems Engineering

Graduate Certificate in Energy Systems Engineering

Mission of the Program

One of the challenges facing society in the 21st century is providing sustainable energy for a growing world population. Widely reported warnings have emphasized the need to develop new sources of energy, while at the same time there is a need to prevent or reverse the environmental degradation. Energy systems are pervasive, affecting nearly every aspect of society. The increasing complexity of these systems, along with increasing environmental constraints, requires practicing professionals in the field to have knowledge, skills, and abilities specific to energy system design, evaluation, construction, and management.

The Master of Engineering and Graduate Certificate in Energy Systems Engineering are interdepartmental programs that address these challenges. The programs provide a foundation in Energy Systems Engineering and Analysis, and Energy Economics and Policy. Students take additional courses in a variety of energy systems areas including biorenewables, wind, combustion, solar, nuclear, and/or energy systems design, or they can specialize in one of these areas if they so choose. These programs will be offered primarily to online (“distance”) students, although on-campus students can choose to take them.

The mission of this new degree is to prepare graduates to be able to design, evaluate, build, and manage complex energy systems. The program will prepare professionals to utilize methodologies for physical and economic assessment of current and future energy needs, applying them in industry, research, and education.

The mission is accomplished through awarding:

1. A Master of Engineering (coursework-only) in Energy Systems Engineering; and
2. A Graduate Certificate (12 credits, coursework-only) in Energy Systems Engineering.

Faculty

Due to the interdisciplinary nature of the program, virtually any graduate faculty member in the College of Engineering could direct the activities of an energy systems engineering graduate student. The major advisor and committee members for students in the program must be approved by the Energy Engineering Supervisory Committee.

Administration

Administrative supervision of the program is the responsibility of the Department of Mechanical Engineering. The Chair selects a Supervisory Committee that oversees the Master of Engineering degree and Graduate Certificate. The Committee shall have at least four members. Committee appointments are for a fixed three-year term beginning on August 1st, with the option

for reappointment. The Committee shall have at least 50% of its members from engineering departments other than Mechanical Engineering.

The Mechanical Engineering Chair appoints one of the committee members as the Director of Graduate Education (DOGE) for the degree and chair of the Committee.

The Committee is charged with making admissions decisions about potential students, making decisions regarding the operation and requirements of the program, approving new courses as appropriate electives, and approving Program Committees and Programs of Study for all students.

Students

Prospective students shall meet the following requirements:

- Bachelors of Science degree in Engineering or Bachelors of Science degree, non-Engineering with:
 - 11 semester credits in math (through differential equations)
 - 16 semester credits in basic sciences
- Minimum of 3.0 undergraduate grade-point average (GPA) – official documentation from previous studies that meets the requirements of the Graduate College. (4.0 scale).
- Official documentation of Graduate Record Exam (GRE) scores. If the undergraduate degree is from a regionally accredited institution, the applicant can request to have this requirement waived.
- International (non-English speaking) students need to take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). Minimum scores for admission are: paper based – 550; computer based – 213; or internet based – 79-80.
- Students with undergraduate degrees from a non-accredited US institution or from a non-US institution are required to submit official documentation of Graduate Record Exam (GRE) scores.

Changes to the Systems Engineering Program

Recommendations for changes in the degree or admissions requirements for the Master of Engineering or Graduate Certificate in Energy Systems Engineering can be made by a majority vote of the Energy Systems Engineering Graduate Program Committee. Any changes must then follow all applicable College of Engineering, Graduate College, and University procedures.

Amendments to the Governance Document

Changes to this governance document require a majority vote of the Energy Systems Graduate Program Committee. In addition, any changes must be approved by the College of Engineering Curriculum Committee.

November 19, 2012

To: To Whom It May Concern

From: Muffit Akinc, Interim Dean



RE: Proposed graduate programs in Energy Systems Engineering

This memo is in support of the proposed Masters of Engineering and graduate certificate in Energy Systems Engineering.

The energy systems engineering graduate program fits well with the strategic goals of the college, both in terms of serving the engineering community and growing the online graduate programs of the college. The graduate programs in energy systems engineering will give practicing engineers the opportunity to strengthen their knowledge and skills in an area that is becoming pervasive across all engineering disciplines.

The Masters of Engineering proposal details a \$30,000 annual commitment by the college to build and sustain the program. This memo confirms that support, which will be provided through Engineering-LAS Online Learning through graduate student recruitment and support, course delivery and marketing.

Should you have any questions, please contact me.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

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<http://www.me.iastate.edu/>

November 16, 2012

To Whom It May Concern:

Re: Proposed graduate programs in Energy Systems Engineering

This memo is in support of the proposed Masters of Engineering and graduate certificate in Energy Systems Engineering. Mechanical Engineering will be the home department for these programs.

Energy systems engineering continues to grow in importance. Practicing engineers need opportunities to strengthen themselves in this area. The online emphasis of these programs provides this. These two programs also fit well with the strategic goals of the department and will help grow our online graduate degree programs.

This memo confirms this commitment by Mechanical Engineering through support staff time. Should you have any questions, please contact me.

Caroline Hayes 
Chair, Department of Mechanical Engineering

Brumm, Thomas J [EOL]

From: rajaman@iastate.edu
Sent: Tuesday, March 10, 2015 10:00 AM
To: brumm@iastate.edu
Subject: RE: response needed

Dear Mr. Brumm:

This email is to confirm that the IEE Engineering Curriculum Committee approved the proposal for a Masters of Engineering and Graduate Certificate in Energy Systems Engineering on September 10, 2015. This constitutes approval of the IEE faculty.

Best,

Raj

*D Raj Raman, PhD, PE | Professor and Associate Chair for Teaching, Department of Agricultural & Biosystems Engineering
University Education Program Director and Pyrone Testbed Champion, NSF ERC for Biorenewable Chemicals (CBIRC)
Iowa State University | 3222 NSRIC Building | Ames, IA 50011 | Voice: 515.294.0465 | E-mail: rajraman@iastate.edu*

Brumm, Thomas J [EOL]

From: Thomas J Brumm [mailto:tbrumm@iastate.edu]
Sent: Wednesday, September 10, 2008 11:04 AM
To: Thomas J Brumm [mailto:tbrumm@iastate.edu]
Cc: Leifien Richard [mailto:leifien@iastate.edu]
Subject: Energy minor and ME degree

Follow Up Flag: Follow up
Flag Status: Flagged

Tom
The Aerospace Engineering Curriculum committee has considered your ME in Energy Systems. We support your proposal and would like a course on composite materials to be included in the program. This course will add value to the education towards the blades made of composite materials.

AerE 522 Design and Analysis of Composite Materials

The course is offered every Fall.

Thanks

Vinay

Dr. Vinay Dayal
Associate Professor
Associate Chairman for Education
Aerospace Engineering Department
1200 Howe Hall, 2271
Iowa State University
Ames, IA 50011
Ph: 515 294 0720
Fax: 515 294 4848
Email: vdayal@iastate.edu
<http://www.public.iastate.edu/~vdayal/>

Brumm, Thomas J [EOL]

From: Mallapragada, T. E.
Sent: Monday, October 8, 2012 1:13 PM
To: Brumm, Thomas J [EOL]
Subject: Re: Minor

Importance: High

Tom

By this e-mail I am confirming that the CBE faculty approved the proposal for a Masters of Engineering and graduate certificate in Energy Systems Engineering on September 27, 2011.

Surya

From: <Brumm>, "Thomas J [EOL]" <tbrumm@mail.iastate.edu>
Date: Monday, October 8, 2012 1:13 PM
To: suryakm <suryakm@mail.iastate.edu>
Subject: RE: Minor

Surya:

Action needed by EOB Wednesday, October 10, please. I'm putting together an info packet for the COE Curriculum Committee meeting on Monday, Oct 15.

I received this email (see below) from you after meeting with your graduate studies committee on September 27, 2011 to discuss the Masters of Engineering and Graduate Certificate in Energy Systems Engineering. We had some back and forth to clarify then, but it would be useful to have a more succinct declaration that CBE supported it.

Could you send me another email? I suggest some language such as this, although you should certainly edit as you see fit.

By this e-mail I am confirming that the CBE Graduate Studies Committee approved the proposal for a Masters of Engineering and graduate certificate in Energy Systems Engineering on September 27, 2011. This constitutes approval by the CBE faculty.

Thanks for your assistance. Let me know if you have questions. Sorry for the request for a short response.

BTW – we are addressing your faculty's concern through the governance committee. Would love to have a CBE representative if your department is so inclined.

Tom

Dr. Tom Brumm
Professor-in-Charge, Engineering-LAS Online Learning
Director of Assessment, College of Engineering
Associate Professor, Ag & Biosystems Engineering
2365 Howe Hall
Iowa State University
Ames, IA 50011
515-294-5145
515-294-6184 fax

Brumm, Thomas J [EOL]

From: Hans van Leeuwen [mailto:hans@ee.eur.nl]
Sent: Monday, October 17, 2011 10:00 AM
To: Brumm, Thomas J [mailto:thomas@ee.eur.nl]
Cc: Fransain, April [mailto:fransain@ee.eur.nl]
Subject: RE: Need response please.

By this e-mail I am confirming that the CCEE Curriculum Committee approved the proposal for a Masters of Engineering and graduate certificate in Energy Systems Engineering on November 17, 2011. This constitutes unanimous approval by the CCEE faculty.

Excuses for late notification. I was CCEE chair then but somehow this was not formalized.

Hans van Leeuwen

Hans van Leeuwen
Enschede
lasta@ee.eur.nl
Professor of Engineering

Brumm, Thomas J [EOL]

From: doug jacobson <dougj@iastate.edu>
Sent: Monday, February 14, 2011 11:00 AM
To: brumm@Thomas & E
Subject: M in En systems

Follow Up Flag: follow up
Flag Status: flagged

Oct 12, 2011 it was approved

Doug

--

Doug Jacobson
University Professor, Dept. Electrical & Computer Engineering
Director: ISU Information Assurance Center Mail Address: 2215 Coover Hall Iowa State University
PH: (515) 294-8307 Fax (515) 294-7582
Office: 203 Nuclear Engineering Lab
Center web site: <http://www.iac.iastate.edu> Personal web site: <http://www.dougj.net>

Brumm, Thomas J [EOL]

From: Jo Min <jomin@iastate.edu>
Sent: Friday, November 11, 2011 11:00 AM
To: tbrumm@iastate.edu; theindel@iastate.edu
Cc: Terpenning; anis; IMSE
Subject: Results: Energy Systems Graduate Program Proposal

Follow Up Flag: Follow up
Flag Status: Labeled

Tom and Ted,
I would like to inform you that the Energy Systems Graduate Program Proposal has been approved by the IMSE faculty. We are also asking for the inclusion of IE 543X Wind Energy Manufacturing (as I recall this course is listed in the Energy Systems minor already). Many thanks.

Jo Min
IE Curriculum Chair

Brumm, Thomas J [EOL]

From: Shrotriya, Pranav [M E]
Sent: Tuesday, October 03, 2011 11:00 AM
To: Brumm, Thomas J [EOL]; Heindel, Theodore J [M E]
Subject: Re: ME approval of new graduate degree

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Tom

The certificate and M Eng degree proposal were approved by the faculty. Please let me know if you need more information.

Thanks
Pranav

On 10/4/11 5:42 AM, "Brumm, Thomas J [EOL]" <tbrumm@mail.iastate.edu> wrote:

Pranav:

That's fine to circulate the proposal to get feedback. Attached is an updated version – we've added some language to specify how courses make it on the "approved list."

Tom

Dr. Tom Brumm
Professor-in-Charge Engineering Online Learning
Professor-in-Charge LAS Center for Distance & Online Learning
Director of Assessment, College of Engineering
Associate Professor, Ag & Biosystems Engineering
409 Marston Hall
Iowa State University
Ames, IA 50011
515-294-5145
tbrumm@iastate.edu <<mailto:tbrumm@iastate.edu>>



PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

From: Shrotriya, Pranav [M E]
Sent: Monday, October 03, 2011 4:42 PM
To: Brumm, Thomas J [EOL]
Cc: Heindel, Theodore J [M E]
Subject: Re: ME approval of new graduate degree?

Dear Tom

I just realized that the diversity committee has organized a workshop during our scheduled meeting time on October 7th so I will have to cancel our scheduled graduate committee meeting for that day. I don't want to keep you waiting till

Brumm, Thomas J [EOL]

From: Vitalij V. Pecharsky [mailto:vp@ameslab.com]
Sent: Friday, October 1, 2010 1:00 PM
To: tbrumm@iastate.edu
Cc: steve@man.iastate.edu; tan@iastate.edu; ustunda@iastate.edu; ratlie@iastate.edu; riley@iastate.edu
Subject: Proposed Energy Systems Engineering Degree
Follow Up Flag: Follow up
Flag Status: Flagged

Tom,

Materials Science and Engineering Graduate Studies Committee appreciates your presentation of Masters Degree Program in Energy Systems Engineering today. The Committee offers its full support of the proposed minor.

Best wishes,

Vitalij Pecharsky
Director of Graduate Education
Materials Science and Engineering Department

Energy Systems Engineering Master of Engineering (MEng)
Energy Systems Engineering Graduate Certificate

Results of Votes in the Approval Process

9/6/2013

Tom Brumm (tbrumm@iastate.edu)

College of Engineering Curriculum Committee

Approved both programs on December 3, 2012 with a vote of 8-0.

Recording Secretary: Roberta Overton (roverton@iastate.edu)

Graduate Council Catalog and Curriculum Committee

Approved both programs on April 9, 2013 with a vote of 4-0.

Recording Secretary: Judy Strand (jstrand@iastate.edu)

Graduate Council

Approved both programs on April 18, 2013 with a vote of 12-0.

Recording Secretary: Judy Strand (jstrand@iastate.edu)

Experimental Course Announcement Page 1 of 2 pages

Reason for proposal (programmatic justification, need for course, intended use in new catalog, etc.):

This course provides an overview of energy systems and forms one of two required courses for the masters of engineering degree in energy systems. It will be available through Engineering On-Line Learning and directed towards both on-campus and off-campus students.

Course outcomes/objective (i.e., what you expect students to know or be able to do when they complete the course):

At the end of this course, students will understand various energy systems and will be able to complete a thermodynamic analysis of these systems. Students will also have the tools to evaluate new energy systems or sub-systems and appreciate the global energy picture.

Course content/major topics to be addressed (attach syllabus if required by your college/department):

See attached syllabus.

Relationship of this course to existing courses in other departments and programs (supporting, overlap, etc.):

This course will be one of two required courses in the proposed masters of engineering in energy systems program. It will be available through Engineering On-Line Learning. It compliments EE 351 – Analysis of Energy Systems, which is a required undergraduate course in our energy systems minor program. There is currently no similar course at the graduate level.

Results of consultation with relevant departments and programs:

The instructor's home department, mechanical engineering, supports the development of this course.

College of LAS use Only.

The dean's approval is contingent upon separate attached documentation, from the department chair identifying how resources will be allocated to fund the proposed course.

Do you propose that the course be acceptable for General Education requirement credits? Yes No

Areas in which group _____

Course: ME 531 – Advanced Energy Systems and Analysis

Instructor: Ted Heindel, Bergles Professor of Thermal Science, Department of Mechanical Engineering
theindel@iastate.edu; 515-294-0057

Catalog Description: **ME 531. Advanced Energy Systems and Analysis.** (3-0) Cr. 3. F. *Prereq:* Any undergraduate thermodynamics course; mathematics through differential equations. Energy systems will be introduced, including economic and thermodynamic principles. Various production systems will be analyzed. Applications to transportation and building systems will be emphasized. Sustainability, climate change, and other current energy system topics will also be addressed.

Textbook: Vanek, F.M., Albright, L.D., and Angenent, L.T., *Energy Systems Engineering: Evaluation and Implementation*, 2nd Edition, McGraw-Hill, New York, 2012.

Grading Policy: Homework – 25%
Review paper/project – 25%
Exams – 50%

Course Syllabus

Week	Topics
1	Overview; Economics
2	Economics; Thermodynamics
3	Thermodynamics
4	Fossil Fuels
5	Nuclear Energy
6	Solar Energy
7	Wind Energy
8	Biofuels
9	Energy Storage
10	Transportation Systems
11	Building Systems
12	Building Systems
13	Climate Change; Sequestration
14	Sustainability; Life Cycle Assessment
15	Project Presentations

Experimental Course Announcement

(page 1 of 2 pages)

Use your computer to complete this form.

Click in grey fields to type

College: Engineering Program or Department: Mechanical Engineering

Complete the following to provide a course listing as it would appear in the catalog. Complete all fields that apply to your course. For more information about catalog format, see <http://www.registrar.iastate.edu/forms/exp-policy.doc>

Designator: M E Course Number: 510X Title: Energy Engineering Economics and Policy

Dual-listed with: _____ Same as: _____
(Cross-listed with another course)

Prerequisites(s), if applicable: Graduate standing

Credits: Fixed 3 Instructor: Morrow

Grading Method: A-F S-F Semester (F, S, 1) and Year to be Offered: S 2013 (S 2014 and S 2015 thereafter)

Catalog Description (See Experimental Course Procedures for instructions on completing this section):

M E 510x. Economics and policy for energy systems in the US as relevant to system engineering. Covers: economic analysis of conventional energy commodity markets and technologies, deregulated electricity markets, and emerging energy technologies; demand forecasting; economic and environmental policy in energy; integrated assessment; and contemporary issues (semester-specific). Grading through problem sets, two exams, and a research project.

Please check all that apply to this course:

Dual List: file dual-list proposal, see www.registrar.iastate.edu/forms/.

Cross-list: Course description appears in catalog with all departments/programs responsible for the course.

Teaching department will be: M E

May be taken **more than once** for credit. If checked, indicate limits below:

Nonmajor graduate credit: 300 and 400-level courses

Special course fees: use the special course fee authorization process on AccessPlus.

Instruction Type(s)	Contact Hours* per week by type
	Hours
	Hours
	Hours

*For partial term courses, include 16-week equivalent for contact hours. See www.registrar.iastate.edu/courses/offeringinfo.shtml

U.S. Diversity and International Perspectives Requirement: Syllabus must be attached to this form.

U.S. Diversity Requirement

International Perspective Requirement

Approvals: please type name(s); add initial and date in the space below. Names must be legible

Prog. or Dept. Curr. Comm. Chair	Prog. or Dept. Chair	College Curr. Chair	Dean's Initials

Graduate College: _____

Cross List Approvals: please type name(s); add initial and date in the space below. Names must be legible

Dept. or Prog.	Cross Listed Prog. or Dept.	Prog. or Dept. Curr. Comm. Chair	Dept. or Prog. Chair	College Curr. Chair	Dean's Initials

Submit originals for pages 1 and 2, with all initials to the Registrar's Student Scheduling Office, 10 Enrollment Services Center: by June 1 for fall courses; October 1 for spring courses; and March 1 for summer courses.

Earlier deadlines apply for the Schedule of Classes and other publications. An experimental course offering must be consistent with the policies and procedures approved and distributed by the Faculty Senate Curriculum Committee.

(Rev 10/10)

Registrar Use Only

Received: _____

Terminal Entry: Web Entry: _____

FSSC & Dept Notified: _____

Experimental Course Announcement (page 2 of 2 pages)

Reason for proposal (programmatic justification, need for course, intended use in new catalog, etc.):

Faculty in the College of Engineering have recently proposed a M.Eng Program in Energy Systems. An essential component of an Energy Systems program is an understanding of the interactions between energy technologies, economic markets, and policy decisions that structure energy systems. Currently there are no graduate-level classes that provide the required focus on economics and policy as relevant to Energy Systems engineering, including other proposed courses for the M. Eng. program. All M. Eng. program students will benefit from the proposed course.

Course outcomes/objective (i.e., what you expect students to know or be able to do when they complete the course):

1. Demonstrate knowledge of history, economics, and policy in specific key energy markets affecting US energy systems (oil, coal, natural gas, electricity); 2. Identify and analyze economic and policy issues associated with conventional energy technologies; 3. Identify and analyze potential economic and policy issues for emerging energy technologies; 4. Read, interpret, and compare integrated assessments prepared by energy analysis organizations including the US DOE and IEA; 5. Demonstrate ability to undertake independent research, apply course concepts in a team project.

Course content/major topics to be addressed (attach syllabus if required by your college/department):

In brief: Basic Economic Concepts; Economic Analysis of Resources, Technologies, Markets, and Policy; Modeling Energy Demand; Environmental Energy Policy; Integrated Assessment; Advanced Contemporary Issues. See attached syllabus and schedule drafts for details. None of this material will be covered in T. Heindel's related course proposal for the other M. Eng. core course.

Relationship of this course to existing courses in other departments and programs (supporting, overlap, etc.):

This course does not have significant overlap with other courses at ISU. ME 433, 444 (undergraduate level) cover some economic and regulatory issues. Econ 580, 581 consider some aspects of resource economics relevant to energy policy and economics. Specific technical topics require mathematical and/or statistical skills that will be reviewed in the course, but will focus on applications not covered elsewhere. By filling a gap in the curriculum concerning contemporaneous issues in energy markets, policies, and analysis, supports programs beyond engineering (e.g., Economics).

Results of consultation with relevant departments and programs:

Proposal originally developed in consultation with Jim Bushnell, formally a faculty in Economics at ISU, and Ted Heindel, originator of the M. Eng. proposal. Numerous syllabi from other universities have been reviewed in the development of course material.

College of LAS use Only.

The Dean's approval is contingent upon separate, **attached documentation**, from the departmental chair identifying how resources will be allocated to fund the proposed course.

Do you propose that the course be acceptable for General Education Requirement credit? Yes No

If yes, in which group? _____

From: "Lence, Sergio H [ECONA]" <shlence@iastate.edu>
Subject: RE: Energy Economics Course
Date: February 28, 2013 2:18:09 PM CST
To: "Morrow, William [M E]" <wrmorrow@iastate.edu>
Cc: "Schroeter, John R [ECONS]" <johns@iastate.edu>

Ross:

We have discussed the proposed experimental course. We understand the rationale for having such a course in the proposed degree, but it does not seem to go deep enough into economics to warrant graduate credit for our majors. Thus, our recommendation is that the course be cross-listed with econ, but the econ listing should clearly state "Non-majors only" or "Not for economics majors" (e.g., as in Soc 515 <http://catalog.iastate.edu/azcourses/soc/> or Econ 532 <http://catalog.iastate.edu/azcourses/econ/>). Please note, however, that cross-listing will require a different number, as Econ 509 already exists (see <http://catalog.iastate.edu/azcourses/econ/>). Please let me know if you need more information. Thanks,

Sergio

Sergio H. Lence
Professor and Marlin Cole Chair of International Agricultural Economics
Department of Economics
Iowa State University
Ames, IA 50011-1070
Phone: (515) 294-8960
Fax: (515) 294-6644
Webpage: <http://www.econ.iastate.edu/faculty/lence/>

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From: William Morrow [mailto:wrmorrow@iastate.edu]
Sent: Wednesday, February 27, 2013 1:48 PM
To: Lence, Sergio H [ECONA]
Subject: Re: Energy Economics Course

Sergio,

Of course. Please contact me with any questions that need to be answered.

If you are going to show the course to the curriculum committee, perhaps we should formally propose to cross-list it in Econ? Wouldn't it be basically the same process, with a formal experimental course form?

M E / ECON 510x – Energy Engineering, Economics, and Policy
Technical Elective, 3 cr. (0-6)

Contact Hours

Technical Elective. 3 cr. (0-6)

Lecture: TTh 1 1/2 hrs, Location TBD

Lab: None

Instructor and Contact Info

Assistant Professor W. Ross Morrow

Phone: 515-294-4690

Email: wrmorrow@iastate.edu

Course Materials

- Textbook: Bhattacharyya, S.C., 2011. *Energy Economics: Concepts, Issues, Markets and Governance*. Springer-Verlag.
- Website: <http://www3.me.iastate.edu/morrow/teaching/ME509x>

Other supplementary Material

- Numerous other readings, assignments, and resources will be made available through the course website.

Course Description

- A broad view of economics and policy aspects of existing and future energy systems in the US relevant for engineers. Review and apply economic and financial analysis techniques necessary to understanding energy technology and energy systems to existing energy markets (e.g., oil, coal, natural gas, electricity), project selection and management (e.g., real options), economic aspects of important future technologies compared to conventional technologies (e.g., wind, solar, bioenergy), and forecasting energy demand (e.g., electricity, liquid fuels). Covers historical and current topics in energy policy, motivating economic theories, observed outcomes in energy markets and systems, and policy forecasting tools including integrated assessment. Graded via problem sets, two exams, and application through an independent research project.
- Prerequisites: Graduate standing. Course includes topics that require a strong background in energy technologies (e.g., M E 531x), calculus, and statistics.

Course Outcomes

Upon completion of 510x, students will be able to:

1. Demonstrate competent knowledge of history, economics, and policy in specific key energy markets affecting US energy systems (oil, coal, natural gas, electricity);
2. Identify and analyze economic and policy issues associated with conventional energy technologies;
3. Identify and analyze potential economic and policy issues for emerging energy technologies (wind, solar, bioenergy);
4. Read, interpret, and compare integrated assessments prepared by energy analysis organizations including the US DOE and International Energy Agency (IEA);
5. Demonstrate ability to undertake independent research and apply course concepts to a novel team project on a topic of the students' interest.

Course Topics

1. *Basic Economic Concepts*
Topics: understanding energy system data; microeconomic theories of behavior; review of econometrics (economic statistics, including regression analysis, time series analysis, elasticities, and rebound effects); finite-resource economics; market structure (natural monopoly, oligopoly, imperfect competition, market power); market failures. These topics are covered in more depth in other courses, but will be reviewed here to provide a solid foundation for specific analysis of energy systems.
2. *Resources, Technologies, Markets, and Policy*
Topics: economics of fossil fuel exploration, extraction, world/regional markets, and use covering oil, natural gas, coal; economics of electricity generation (investments and operation of production technology, infrastructure economics, “de”-regulated market structure in the US); challenges for renewables (wind, solar, bioenergy).
3. *Modeling Energy Demand*
Topics: residential & commercial electricity demand and transportation fuel demand.
4. *Environmental Energy Policy*
Topics: review of basic economic concepts (externalities, tragedy of the commons, public/private goods, common pool resources); pollution control regulations; efficiency standards; vehicle fuel economy regulations; climate change policy; renewable fuels policy. Focus is on economic impacts of policy decisions given technological realities and projections.
5. *Integrated Assessments*
Topics: review, interpretation, and analysis of several models used by the US government, academics, and NGOs, including a critical review of recent policy impact forecasts made by DOE’s EIA or the IEA using such models.
6. *Advanced, Contemporary Issues*
Topics: to be determined each semester. May include: complex behavior, energy investments, and energy use; demand management and dynamic pricing in the smart grid; markets for advanced cellulosic biofuels.

Grading (and other required elements of the course)

1. Participation: 10%
A tenth of student’s grade will be determined based on attendance and *active* participation in the lectures.
2. Problem Sets: 40%
Determined by performance on 10 approximately weekly problem sets that review and enhance understanding of the technical material presented in the lecture and reading material. Most assignments will involve assigned readings outside material covered in class that confront assumptions in the analysis presented in class.
3. Exams: 40%
There will be a midterm exam and a final exam covering technical concepts in the course. Both exams will include two types of questions: (a) problems in mathematical modeling and analysis of energy systems (of a complexity relevant to an in-class exam setting) and (b) “essay”-based questions in which students will be asked to discuss relevant topics in energy market history relevant to technology, economics, and policy.
4. Project: 10%
Students will apply and expanding the knowledge gained in the class in a small student team project concerning an area of the students’ interest. Project topics will be proposed early in the course, approved by the instructor, and summarized in a final presentation to the class with an accompanying report.

Disability Needs

If you have a disability and require accommodations, please contact the instructor early in the semester so your learning needs may be appropriately met. You will need to provide documentation of your

disability to the Student Disability Resources (SDR) office, located on the main floor of the Student Services Building, Room 1076, 515-294-7220.

M E / ECON 510x Schedule (DRAFT)

Reading List

Abbreviation	Text
EE	Bhattacharyya, 2011. <i>Energy Economics: Concepts, Issues, Markets, and Governance</i> . Springer-Verlag. (Required)
SA	Shahidehpour & Alomoush, 2001. <i>Restructured Electrical Power Systems: Operation, Trading, and Volatility</i> . Marcel
PR	Pindyck & Rubinfeld, 2008. <i>Microeconomics</i> . Prentice Hall.

Week	Lecture Focus	Assignment	Reading	Other Materials	
1	Introduction	Course Introduction	EE(1,2)	"Energy" Chapter, from <i>Physics for Future Presidents</i> by Richard Muller	
	Basic Economic Topics	Understanding Energy Data and Statistics	Team Surveys	EE(2)	EIA Statistics, IEA Statistics, BP Statistical Review of Energy
		Regression Analysis (single & multi-variate, estimation software, significance and regressor co-linearity)		EE(3,8,5.1)	
2		Standard Models: CES models, Local Elasticities, Rebound Effects	Project Topic Memo		
		Time Series Analysis		Cochrane, 2005. <i>Times Series Analysis</i> .	
		microeconomic theories of behavior	EE(3)	PR(3,8)	
3		Economics of Rival Resources	Data Analysis, Statistics, Basic Regression	EE(9)	Hardin, 1968. "Tragedy of the Commons" <i>Science</i> .
		Monopoly, Oligopoly, Market Power		EE(9.3,12.3)	PR(10,11,12)
		Economics of Energy Investments; Futures Markets		EE(7,21)	SA(6)
4	Resources, Technologies, Markets, and Policy	Fossil Fuels - Oil, Gas & Coal: sources, uses, and basic statistics	Time Series, Micro, Limited Resources	EE(8)	
		Oil - economics of resource extraction and product production technology (domestic & foreign)		EE(8)	Energy Charter Secretariat (2007 & 2011)
		Oil - markets (monopoly, cartel), prices, and regulations; recession effects		EE(8,14.1-2)	Energy Charter Secretariat (2007 & 2011), Platt's methodologies
5		Natural Gas - economics of resource extraction	Monopoly / Oligopoly Models	EE(8,15.1-2)	
		Natural Gas - modeling markets & major policies		EE(8,15.3-6)	Press coverage of Fracking (emerging policy discussion)
		Coal - extraction technology and markets (prices)		EE(8,16)	"History of Coal Markets", World Coal Institute report, EIA's annual coal report
6		Electricity - production technology, associated capital and operating costs; metrics (e.g., LCOE)	Oil and Gas Markets	EE(10)	
		Electricity - Economics of transmission & distribution; day-ahead markets and unit commitment		EE(10,28,29)	SA(1,2)
		Natural Monopoly, Market Failures and Externalities		EE(12)	PR(18)
7	(Teaching Buffer Day)				
		"Renewables" - Economics of Hydropower and Nuclear Power			
		Renewables - Wind (technological & economic challenges)		EE(11)	DOE (annual). <i>Wind Technologies Market Report</i> .
8		Renewables - Solar (technological & economic challenges); SunShot program	Deregulated Electricity Markets	EE(11)	DOE, 2012. <i>SunShot Vision Study</i> .
		Renewables - Bioenergy, Biofuels (technological & economic challenges)		EE(11.3-6)	Searchinger et al, 2008, <i>Science</i> . DOE, 2011. <i>US Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry</i> .
Exam Review					

9	MIDTERM EXAM (Through Deregulated Electricity Markets)			
Energy Demand	Overview of Energy Demand Modeling.		EE(3)	
	Demand for Residential & Commercial Electricity (load forecasting)		EE(4,5)	Residential Energy Consumption Survey (EIA)
10	Energy Demand - Transportation Renewables (driving demand models, fuel pricing models)		EE(4,5)	Transportation Energy Data Book (ORNL), Hughes, Knittel, & Sperling (2008), Larrick & Soll (<i>Science</i> , 2008)
Environmental Energy Policy	Review: Theory of Environmental Externalities; Public Goods, Private Goods, and Common Pool Resources		EE(23)	Ostrom et al., 1998, 1999. <i>Science</i> .
	Pollution Control; Economics of MACT policies and Cap & Trade programs (SO ₂)		EE(24,25)	Greenstone - Sulfur Dioxide
11	Fuel Economy and GHG emissions intensity Policy (the "National Program")	Energy Demand		NRC (2002/2011), Greene ("Why CAFE Worked"), Michalek et al., 2011, <i>PNAS</i> .
	Climate Policy - Overview of Climate Change and energy's contribution; emissions standards, Cap & Trade, international actions		EE(26)	IPCC Policy Summary (2007), <i>Acting In Time</i> (Brookings, 2010), Sterman (<i>Science</i> , 2008)
	Renewable Fuel Standard, Low-Carbon Fuel Standards			EPA websites and final rules regarding the US RFS.
Thanksgiving Break				
13	Interpreting Energy Policy Analyses Reports	Integrated Assessment Models (IAMs) - Overview & NEMS	Env. Energy Policy	EE(17) EIA's NEMS Documentation
		Integrated Assessment Models (IAMs) - Other Models (EPPA, MARKAL)		EE(17) MIT EPPA Reports, various analysis papers
		EIA & IEA Reports - Annual Energy Forecasts		EE(17) Most recent Annual Energy Outlook (AEO) and World Energy Outlook (IEA)
14	Advanced Contemporary Issues in Energy Economics and Policy (TBD)	Behavior and Energy Efficiency		EE(6) Allcott et al (<i>Science</i> 2008), Larrick & Soll (<i>Science</i> 2008),
		Demand Management and Dynamic Pricing		EE(6) TBD
		Advanced Cellulosic Drop-In Biofuels	Critical Review of a chosen analysis w/ an IAM	- TBD
15	(Teaching Buffer Day)			
	Student project presentations		-	
	Student project presentations		-	
FINAL EXAM (Date TBD); Project Reports Due				

Courses in departments outside of Engineering listed as electives:

- Computer Science
- Economics
- Finance
- Human and Computer Interaction
- Management and Marketing
- Mathematics
- Physics
- School of Education (HGED)
- Statistics
- Supply Chain Management and Information Systems
- World Languages and Cultures

Brumm, Thomas J [ELO]

From: Wong, Johnny S [COM S] <wong@iastate.edu>
Sent: Friday, September 06, 2013 8:45 AM
To: Brumm, Thomas J [ELO]
Cc: wong@iastate.edu; Heindel, Theodore J [M E]
Subject: Re: Need your approval please

Hi Tom,

I am sorry if I have not done so, as I was traveling at that time.
Our graduate committee has agreed with the proposal to use Com S 477/577 in the Master program.

Hence, I approve your request.
Thanks!

Best regards!
Johnny Wong
Professor & Interim Chair, Computer Science Department
Professor, Information Assurance Center (IAC)
Professor, Human Computer Interaction (HCI)
Iowa State University
Ames, Iowa 50011
USA
Website: <http://www.cs.iastate.edu/~wong>
Email: wong@iastate.edu

On Sep 6, 2013, at 8:39 AM, "Brumm, Thomas J [ELO]" <tbrumm@iastate.edu> wrote:

Dr. Wong:

This is a friendly reminder of my 7/16 request for approval to use ComS 477/577 in the Energy Systems Engineering master's program. We are putting together the information for approval by the Faculty Senate and need a response from ComS in the next week.

Thanks!

Tom

=====

Dr. Wong:

ACTION REQUESTED: a return email of approval for using Computer Science courses in a graduate program.

We are in the process of developing a coursework-only Masters of Engineering Degree in Energy Systems. The entire proposal is attached for your reference. Of the required 30 credits:

- a minimum of three must come from a list of approved graduate-level math/statistic courses
- three must come from a list of professional development courses.

From: [Schroeter, John R. \[ECONS\]](#)
To: [Heindel, Theodore J. \[M. E.\]](#)
Subject: RE: Dept. of Economics Approval Needed
Date: Wednesday, July 24, 2013 1:28:39 PM

The Department of Economics is aware that one or more of its courses has been identified as an elective course to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of its use and encourage their students to register for our courses.

Sincerely,

--

John R. Schroeter
Professor and Interim Chair
Department of Economics
Iowa State University
Ames, IA 50011-1070
515.294.5876 (voice)
515.294.0221 (fax)
johns@iastate.edu

Brumm, Thomas J [ELO]

From: Dark, Frederick H [FIN]
Sent: Friday, September 06, 2013 10:46 AM
To: Brumm, Thomas J [ELO]
Cc: Heindel, Theodore J [M E]; Hu, Qing [BUS]
Subject: RE: Action requested: approval of FIN course for graduate degree

Tom,

The Department of Finance is aware that FIN 501 is being used as an elective course to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of its use and encourage their students to register for the course.

Sincerely,
Rick

Rick Dark
Chair, Department of Finance
College of Business
Iowa State University
2330 Gerdin Business Building
515-294-8112

From: [Oliver, James H \[M E\]](#)
To: [Heindel, Theodore J \[M E\]](#)
Subject: HCI course approval
Date: Tuesday, August 13, 2013 9:07:02 AM

Dear Ted,

The HCI program is aware that one or more of its courses has been identified as an elective course to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of its use and encourage their students to register for our courses.

Regards,

Jim

James H. Oliver
University Professor
Larry and Pam Pithan Professor of Mechanical Engineering
Director, Virtual Reality Applications Center
Director, Graduate Program in Human Computer Interaction
2274 Howe Hall, Room 1620
Iowa State University
Ames, IA, USA 50011
Office: 515.294.2649
Mobile: 515.450.2093

Brumm, Thomas J [ELO]

From: Lacznia, Russell N [MKT] <lacznia@iastate.edu>
Sent: Monday, September 09, 2013 11:50 AM
To: Brumm, Thomas J [ELO]
Cc: Heindel, Theodore J [M E]; Hu, Qing [BUS]
Subject: RE: Action requested: approval of Mgmt & Mkt courses for graduate degree

Tom:

I checked with the Management and Marketing Departments about your proposal. Al-in-all they are pretty positive about the program and our involvement. But, the Management Department expressed some concern with the inclusion of MGMT 472. Even though the course can be taken for graduate credit, the department thought that some of their graduate-level courses (e.g., MGMT 570 and 571) would better meet your objectives. So, as a friendly suggestion, the department asks that 570 and 571 be included and 472 be dropped.

Russ

Russell N. Lacznia, Ph.D.
Chair, Departments of Management & Marketing
John and Connie Stafford Fellow
College of Business
Iowa State University
2350 Gerdin Business Building
Ames, IA 50011-1350

NOTE: this requested adjustment was made in the proposal.

From: Brumm, Thomas J [ELO] [mailto:tbrumm@iastate.edu]
Sent: Friday, September 06, 2013 8:48 AM
To: lacznia@iastate.edu
Cc: Heindel, Theodore J [M E]; Hu, Qing [BUS]
Subject: Action requested: approval of Mgmt & Mkt courses for graduate degree

Dr. Lacznia:

ACTION REQUESTED: a return email of approval by 9/13 for using Management and Marketing courses in a graduate program.

I sent this request to Qing Hu in July and am unsure if it reached you.

We are in the process of developing a coursework-only Masters of Engineering Degree in Energy Systems Engineering. The entire proposal is attached for your reference. Of the required 30 credits:

- a minimum of three must come from a list of approved graduate-level math/statistic courses
- three must come from a list of professional development courses.

For your department, approved courses are MGMT 472, MGMT 503, MGMT 583, and MKT 501.

Brumm, Thomas J [ELO]

From: Bergman, Clifford [MATH]
Sent: Tuesday, July 23, 2013 1:05 PM
To: Brumm, Thomas J [ELO]
Cc: Jennifer Davidson
Subject: Approval to use Math courses to meet requirements
Attachments: Energy Systems Engineering MEng BOR Proposal 2013-04-09.pdf

The Department of Mathematics is aware that one or more of its courses is being used as an elective course to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of its use and encourage their students to register for our courses.

Sincerely,
Clifford Bergman,
Chair, Department of Mathematics

Cliff Bergman, Chair
Department of Mathematics
Iowa State University
Ames, IA 50011 USA
515-294-8137

From: [Krennrich, Frank \[PHYSA\]](#)
To: [Heindel, Theodore J \[M. E.\]](#)
Cc: [Frank Krennrich](#)
Subject: Re: Dept. of Physics and Astronomy Approval Needed
Date: Tuesday, August 13, 2013 4:26:51 PM

Hi Ted,
here is my statement:

The Department of Physics and Astronomy is aware that one or more of its courses has been identified as an elective course to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of its use and encourage their students to register for our courses.

Sincerely,

[Department Chair]

=====

Frank Krennrich

From: [Schuh, John H \[SOE\]](#)
To: [Heindel, Theodore J \[M. E.\]](#)
Cc: [Licklider-Barb](#)
Subject: HGED 561
Date: Friday, July 19, 2013 2:01:58 PM

Greetings.

We are very pleased that you have included HGED 561 (College Teaching) in your proposed curriculum for the Master of Engineering degree in Energy Systems. and are pleased to endorse this decision. The course is taught every term (Fall, Spring and Summer) but it is very popular and often fills up quickly.

If you have any questions, please be sure to contact me at your convenience.

Best wishes,

JHS

John H Schuh
Director, School of Education and
Distinguished Professor
Iowa State University
Ames, IA 50011
515-294-2336
515-294-6206 (FAX)

Brumm, Thomas J [ELO]

From: Koehler, Kenneth J [STAT] <kkoehler@iastate.edu>
Sent: Tuesday, July 16, 2013 2:34 PM
To: tbrumm@iastate.edu
Cc: kkoehler@iastate.edu
Subject: Proposed program in Energy Systems Engineering
Attachments: Energy Systems Engineering MEng BOR Proposal 2013-04-09.pdf

Tom,

The Department of Statistics is aware that all of our 400, 500 or 600 level courses are included in a list of possible elective courses to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of the use of any of those courses. Since this is intended to be an online program, it may be useful to know that we currently offer the following courses online: Stat 401, 402, 495, 496, 500, 510, 520, 542, 542, 544, 512, 501, 503, 521, 531, 533, 585X, 579, 551, 565, 557, and 501. We encourage students pursuing Masters of Engineering Degree in Energy Systems to enroll in any of these courses, and we would be happy to provide advice to individual students on which of these courses would best meet their needs.

Sincerely,

Ken Koehler

*Kenneth Koehler
Professor and Chair
Department of Statistics
1121H Snedecor Hall
Iowa State University
Ames, Iowa 50011*

*E-mail: kkoehler@iastate.edu
Telephone: 515-294-4181
Fax: 515-294-4040*

Brumm, Thomas J [ELO]

From: Nilakanta, Sree [SCIS] <nilakant@iastate.edu>
Sent: Wednesday, July 17, 2013 11:52 AM
To: tbrumm@iastate.edu
Cc: Nilakanta, Sree [SCIS]; Hu, Qing [BUS]
Subject: Energy Systems Engineering

Tom,

The Department of Supply Chain and Information Systems is aware that one or more of its courses is being used as an elective course to satisfy the degree requirements in the proposed Masters of Engineering Degree in Energy Systems. We approve of its use and encourage their students to register for our courses.

Sincerely,

Sree Nilakanta, Ph.D.
Chair
Department of Supply Chain & Information Systems
David & Deb Kingland SCIS Suite
2340 Gerdin Business Building
Ames, Iowa 50011-1350
Tel: +1 515 294 8113
email: nilakant@iastate.edu
url: www.business.iastate.edu/faculty/nilakant

“Boldness of enterprise is the foremost cause of rapid progress, its strength and its greatness,” Alexis de Tocqueville

From: [Gasta, Chad \[WLC\]](#)
To: [Theodore Heindel](#)
Subject: WLC Approval for Energy Systems
Date: Thursday, August 15, 2013 6:25:04 AM

Dear Professor Heindel,

I am pleased to inform you that the Department of World Languages and Cultures is supportive of the Masters of Engineering in Energy Systems and approves the use of WLC courses as electives to satisfy the degree requirements. We moreover will encourage eligible students to consider applying to this new Masters program and likewise to consider enrolling in the WLC courses for credit.

Congratulations on your decision to move forward with this unique and important proposal and please let me and my colleagues know how we may support your endeavors.

Sincerely,
Chad M. Gasta

Chad M. Gasta
Associate Professor and Chair
World Languages and Cultures
Director, International Studies
Co-Director, Languages and Cultures for Professions (LCP)
Iowa State University
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