

QEM 570
Energy Management and Conservation
Course Syllabus and Topic Outline

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Campus Office Hours: 10:00 am - 10:50 am M-W-F
2:00 pm - 3:00 pm M-W-F
Available on Skype by appointment

Textbook: Guide to Energy Management, 7th Edition, Barney L. Capehart, Ph.D., CEM, Wayne C. Turner, Ph.D., PE, CEM, William J. Kennedy, Ph.D., PE

References: The Dranetz Field Handbook for Electrical Energy Management, Dranetz Technologies, Inc. 1992.
Energy Management Handbook, 4th Edition, Wayne C. Turner
Plant Engineers and Managers Guide to Energy Conservation, 10th Edition, Albert Thumann, PE, CEM, Scott Dunning, Ph.D. PE, CEM

Grading Scale:	100-90%	A
	89-80%	B
	79-70%	C
	69-60%	D
	59-below	F

Lesson Quizzes (Drop the lowest 7 scores)	60%
Final Exam (200 points)	20%
Homework	10%
Discussion Board Activity	10%

Total	100%

Online Course Operation and Technical Notes

This course is taught online only through the Desire2Learn course management system hosted by SIUC and found through the SIUC homepage under the SIU Online link. You should log on and familiarize yourself with this system before proceeding to the lessons.

You may need to download and install software such as MS Silverlight, and Flashplayer to view the course content. The course webpages include links to these resources. The course materials will display correctly in Firefox and Google Chrome. There are some display issues with MS Explorer regarding page formatting.

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Online Course Operation and Technical Notes (cont.)

The course presentation webpages may take a VERY long time to load. Be patient. The presentations use flash movie format (SWF files) that can take a while to load. This content could take 5-7 minutes to load on DSL connections. It will load much faster after the initial access. Contact the course instructor if you are unable to view any of the course material.

This course includes several homework assignments. These assignments require electronic submission of written work. The best method for handing in these assignments is to write your work as you would do for a face-to-face class using a soft pencil and then scan the pages to a pdf format. This format gives the smallest file sizes with good resolution. The course instructor can make electronic notes and corrections on work submitted in this format. You will have electronic copies of these corrections returned to you in a timely way. The course instructor reserves the right to wait until the final assignment due date before grading an assignment.

Course Policies

1. **Late Work and Testing**

The course management system is set to automatically accept homework assignments during specified periods. Note the due dates for all work. All work submitted after the due dates will not be graded. All quizzes and tests take place online and have time limits that range from 10 to 90 minutes. The learning management system will automatically submit the quiz/test when time is up. Some quizzes allow the student more than one attempt. The highest score of all the attempts becomes the grade for that assignment

2. **Course Progress**

The course content design requires students to work diligently through the individual lessons in order to complete all material by the end of the semester. Lessons are typically shorter than a standard 50 minute campus lecture. Adequate progress is the completion of 3-4 lessons per week. Completing a lesson will require at least the following: reviewing the lessoning introduction, reading/reviewing the lesson reading assignment, viewing the presentation, and completing the lesson quiz. Other lesson requirements may include viewing supplemental videos, participating in online discussions, and completing homework assignment. Students not making adequate progress will be notified.

3. **Homework Assignment File Format**

This course requires students to submit several homework assignments during the semester. Submit these assignments to an electronic dropbox in the learning management system. These dropboxes close after specified time period and will not allow late submissions. Consult the course schedule frequently so that you are aware of the assignment due dates and any changes that many have occurred. Submit all homework by scanning your work into a pdf format file. DO NOT take pictures of the

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pages using a camera or submit any other file format. The course instructor will not grade work submitted in an incorrect format.

Final Exam Scheduling Policy

The course final exam is comprehensive. The course instructor will make the exam available no sooner than 12:00 am 12-10-12, which is the start of campus finals week. All students must complete the final by 12:00 am 12-14-12.

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Course Description and Prerequisites

Energy Management and Conservation (3 Credit hours)

This course covers the basic principles and policies used in energy management and auditing. Proper application of these tools will improve facilities performance and operation, reduce operating costs and environmental impacts, and create a more sustainable business model. Students will learn the importance of monitoring and controlling energy and resource consumption in industrial and commercial settings. The course covers how to develop and implement energy management programs and conduct energy audits. The course covers efficient operation of electric motors, lighting systems, boilers, furnaces, and facilities' climate control. The course covers economic evaluation of energy conservation opportunities using engineering economic formulas, simple pay-back analysis, and life-cycle cost models. The course surveys the current state of energy policy with an emphasis on LEED design and certification.

Prerequisites: Math 150 or IT 307, Physics 203ab or equivalents

Course Outcomes:

Upon completion of this course the student will be able to:

- 1.) Explain the importance of effective energy management and control in commercial and industrial facilities.
- 2.) Develop and implement energy management programs in commercial and industrial facilities.
- 3.) Plan and conduct effective energy audits.
- 4.) Perform economic analysis of energy conservation opportunities and identify cost effective conservation projects.
- 5.) Use Excel to analyze historical energy consumption data.
- 6.) Develop statistical models of energy consumption using widely available software tools.
- 7.) Use statistical models to track the effectiveness of energy management programs.
- 8.) Identify factors that improve the efficiency of electric system operations.
- 9.) Evaluate gas and electric bills for potential cost savings and correctness.
- 10.) Identify factors that impact the performance of electric motors in industrial and commercial applications.
- 11.) Explain how variable speed motor drives improve efficiency and reduce costs.
- 12.) Measure light levels and evaluate systems for adequacy and efficiency
- 13.) Compare and contrast lighting types commonly used in industrial and commercial facilities.
- 14.) Explain the physical process of air compression
- 15.) Compare and contrast different types of compressed air systems for efficiency.

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Course Outline

- I. Introduction
 - a. Value of energy management
 - b. Energy management careers and certifications
 - c. Suggested principles
 - 1. Cost control of energy factors not energy
 - 2. Cost control of energy functions as product cost
 - 3. Control and meter major functions
- II. Developing Energy Management and Auditing Programs
 - a. Corporate structure
 - b. Parts of energy management programs
 - 1. Policy
 - 2. Audit plans
 - 3. Educational plans
 - 4. Reporting systems
 - 5. Strategic plans
 - c. Energy Data Analysis
 - 1. Modeling energy consumption
 - 2. Regression Models
 - 3. Time series representations
 - 4. Cumulative sum of variance plots
 - d. Energy Auditing
 - 1. Tools and preparations
 - 2. Safety
 - 3. Site inspections
 - 4. Identifying energy conservation opportunities
 - 5. Reporting
- III. Electric theory, systems and measurements
 - a. Power systems characteristics
 - 1. Basic electric theory
 - 2. Single phase ac power
 - 3. Active and reactive power
 - 4. Three phase ac systems and power
 - 5. Efficiency
 - 6. Power calculations
 - b. Power factor
 - 1. Calculating power factor
 - 2. Power factor correction
 - c. Electric power and energy measurements
 - 1. Single phase power measurement
 - 2. Three phase power measurement
 - 3. Two-watt meter measurement methods
 - 4. Instrumentation transformers
 - 5. Energy meters

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6. Reading energy meters and estimating power usage

IV. Energy Costs and Bill Analysis

- a. Utility industry trends
 - 1. Regulation-deregulation
- b. Power billing
 - 1. Utility costs
 - 2. Customer classes and rate schedules
 - 3. Commercial and Industrial rates
 - 4. Real time prices
- c. Power Demand
 - 1. Need for demand charges
 - 2. Time/price/demand correlation
 - 3. Demand measures
 - 4. Demand rates
 - 5. Demand ratchets
 - 6. Demand adjustments/low power factor
- d. Computing energy bills
 - 1. Identifying customer rate class
 - 2. Computing delivery charges
 - 3. Computing energy charges
 - 4. Taxes and other charges
- e. Gas billing
 - 1. Physical background and Units
 - 2. Rates
 - 3. Seasonal impact on prices
- f. Fuel oil
 - 1. Types and costs
- g. Coal
 - 1. Types and costs
- h. Other energy sources
 - 1. Steam and chilled water
 - 2. Waste water proxy

V. Economic Analysis

- a. Time-value of money
 - 1. Simple payback analysis
- b. Cash flow diagrams
 - 1. Discount factors
 - 2. Present and future worth
- c. Methods of economic analysis
 - 1. Present worth
 - 2. Future worth
 - 3. Annual worth
 - 4. Benefit cost ratio
 - 5. Internal rate of return

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d. Deprecation and taxes

VI. Lighting

a. Introduction

1. Units and Recommended Lighting levels

b. Components

1. Lamps

2. Ballasts

3. Luminaires

c. Control

1. Timers

2. Photocells

3. Occupancy

d. Measurement tools

VII. Electric Motors and Mechanical Loads

a. Induction motor basics

1. Induction motor operation

2. Nameplate data

3. Torque-speed characteristics

4. Load types

b. Power factor

1. Power factor correction

d. Motor load measurements

1. Instrumentation

2. Slip measurement

3. Current measurement

4. Motor efficiency calculation

5. Motor performance management

i. Motor Master Software

6. Load speed sensitivity

7. Variable speed drives

VIII. Compressed Air and Process Systems

a. Components

1. Compressors

2. Piping

3. Air dryers and filters

b. Process improvement

1. Steps for process improvement

2. Process examples

"We emphasize student achievement and success because achievement and success are essential if we are to shape future leaders and transform lives"

IMPORTANT DATES

Last day to add a class (without instructor permission)..... 8/30/2013
Last day to withdraw completely and receive a 100% refund.....9/01/2013
Last day to drop a course using SalukiNet10/27/2013
Last day to file diploma application (for name to appear in Fall Commencement program).....11/01/2013
Final examinations12/9 – 12/13/2013

Note: For outreach, internet, and short course drop/add dates, visit Registrar's Academic webpage <http://registrar.siu.edu/>

FALL SEMESTER HOLIDAYS

Labor Day 09/02/2013
Fall Break 10/12—10/15/2013
Thanksgiving Break 11/27—12/1/2013

WITHDRAWAL POLICY ~ Undergraduate only

Students who officially register for a session may not withdraw merely by the stopping of attendance. An official withdrawal form needs to be initiated by the student and processed by the University. For the proper procedures to follow when dropping courses and when dropping from the University, please visit <http://registrar.siu.edu/pdf/ugradcatalog1314.pdf>

INCOMPLETE POLICY~ Undergraduate only

An INC is assigned when, for reasons beyond their control, students engaged in passing work are unable to complete all class assignments. An INC must be changed to a completed grade within one semester following the term in which the course was taken, or *graduation*, whichever occurs first. Should the student fail to complete the course within the time period designated, that is, by no later than the end of the semester following the term in which the course was taken, or graduation, whichever occurs first, the incomplete will be converted to a grade of *F* and the grade will be computed in the student's grade point average. *For More information please visit <http://registrar.siu.edu/grades/incomplete.html>*

REPEAT POLICY

An undergraduate student may, for the purpose of raising a grade, enroll in a course for credit no more than two times (two total enrollments) unless otherwise noted in the course description. For students receiving a letter grade of A,B,C,D, or F, the course repetition must occur at Southern Illinois University Carbondale. Only the most recent (last) grade will be calculated in the overall GPA and count toward hours earned. *See full policy at <http://registrar.siu.edu/pdf/ugradcatalog1314.pdf>*

GRADUATE POLICIES

Graduate policies often vary from Undergraduate policies. To view the applicable policies for graduate students, please visit <http://gradschool.siu.edu/about-us/grad-catalog/index.html>

DISABILITY POLICY

Disability Support Services provides the required academic and programmatic support services to students with permanent and temporary disabilities. DSS provides centralized coordination and referral services. To utilize DSS services, students must come to the disability office to open cases. The process involves interviews, reviews of student-supplied documentation, and completing Disability Accommodation Agreements. <http://www.siu.edu/dss>

STUDENT CONDUCT CODE

http://policies.siu.edu/other_policies/chapter3/conduct.html

SALUKI CARES

The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in any type of distress—physical, emotional, financial, or personal. By working closely with faculty, staff, students and their families, SIU will continue to display a culture of care and demonstrate to our students and their families that they are an important part of the community. For Information on Saluki Cares: (618) 453-5714, or siucares@siu.edu, <http://salukicare.siu.edu/index.html>

EMERGENCY PROCEDURES

Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. We ask that you become familiar with the **SIU Emergency Response Plan** and **Building Emergency Response Team (BERT)** program.

Emergency response information is available on posters in buildings on campus, available on BERT's website at www.bert.siu.edu, Department of Safety's website www.dps.siu.edu (disaster drop down) and in Emergency Response Guideline pamphlet. Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. ***It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency.***

INCLUSIVE EXCELLENCE

SIU contains people from all walks of life, from many different cultures and sub-cultures, and representing all strata of society, nationalities, ethnicities, lifestyles, and affiliations. Learning from and working with people who differ is an important part of education, as well an essential preparation for any career.

MORRIS LIBRARY HOURS

<http://www.lib.siu.edu/about>

LEARNING AND SUPPORT SERVICES

Help is within reach. Learning support services offers free tutoring on campus and math labs. To find more information please visit Center for Learning and Support Services website for:

Tutoring : <http://tutoring.siu.edu/>

Math Labs http://tutoring.siu.edu/math_tutoring/index.html

WRITING CENTER

The Writing Center offers free tutoring services to all SIU students and faculty. To find a Center or Schedule an appointment please visit <http://write.siu.edu/>

AFFIRMATIVE ACTION & EQUAL OPPORTUNITY

Our office's main focus is to ensure that the university complies with federal and state equity policies and handles reporting and Investigating of discrimination cases. *For more information visit <http://diversity.siu.edu/#>*

Additional Resources Available:

SALUKINET: <https://salukinet.siu.edu/cp/home/displaylogin>

ADVISEMENT: <http://advisement.siu.edu/>

PROVOST & VICE CHANCELLOR: <http://pvcaa.siu.edu/>