MFGS 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  

References:  
Plant Engineers and Managers Guide to Energy Conservation, 10th Edition, Albert Thumann, PE, CEM, Scott Dunning, Ph.D. PE, CEM  

Grading Scale:  

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Grade</th>
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<tr>
<td>100-90%</td>
<td>A</td>
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<td>89-80%</td>
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<td>79-70%</td>
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<td>69-60%</td>
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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.
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.

Course quizzes require use of the Respondus lockdown browsers. This browser prevents users from accessing the web our other programs while the quiz is in progress. Install this software before attempting any course quizzes. This software is available for download from the opening of SIU online.

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 30 minutes. The learning management system will automatically submit the quiz/test when time is up. The testing will require the Respondus Lockdown Browser. Download this from Desire2Learn before beginning the first quiz.

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.

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.
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.) Explain the concept of heat flow in buildings for energy management applications.
6.) Calculate and utilize thermal resistance and conductance values to determine heat flow from a building envelop.
7.) Use software to determine building envelope heat transfer.
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 operation of boilers and furnaces.
15.) Compare and contrast air conditioning systems in terms of operation and efficiency.
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
d. Depreciation 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. Optimal 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

IX. Building Envelope Analysis
a. Fundamentals of heat flow
   1. Thermal resistance
   2. Heat flow by conduction
   3. Heat flow by convection
b. Factors affecting building heat loss
   1. Temperature
2. Materials/Construction
   i. Walls
   ii. Floors
   iii. Windows
   iv. Insulation
3. Infiltration
4. Optimal Insulation levels
   c. EQuest building modeling software
d. Models from billing data
e. LEED Design
X. Heating Ventilating and Air Conditioning
   a. Analysis of boilers and fired systems
      1. Units
      2. Energy consumption and cost
      3. Energy and mass balance
      4. Efficiency
      5. Maximizing efficiency
   b. Heating ventilating and air conditioning systems (HVAC)
      1. Thermal comfort
      2. Systems types
      3. Conservation opportunities
         i. Demand management
         ii. Setback
         iii. Economizers