## COURSE OUTLINE

<table>
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<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>ERG 112</td>
<td>Energy Audit and Weatherization</td>
<td>3</td>
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**Hours:** 2/2 lecture/Lab/Other  
**Co- or Pre-requisite:**  
**Revised:** Spring 2010

### Course description:
Introduction to the analysis of energy use in buildings, the basic principles of insulation and weatherization, and the tools needed to conduct an energy audit. Topics include heat transfer through the building envelope, applicable codes and regulations for residential and light commercial building systems.

### Is course New, Revised, or Modified? New

### Required texts/other materials:

### Revision date:
Spring 2014

### Course Coordinator:
Garry Perryman, 3357, perryg@mccc.edu

### Information resources:

### Other learning resources:
Course Competencies/Goals:
1. Understand the basic principles of energy (what is energy, heat flow, thermal comfort, converting energy for building uses)
2. Acquire a working knowledge of the energy auditing process.
3. Identify and explain the necessary assessment tools, energy audit software and procedural concepts regarding energy auditing.
4. Solve basic heating and cooling load problems, including solving R-Value and quantifying overall building thermal performance.
5. Develop a written energy audit report estimating energy use given local climate criteria, thermostat setting, roof overhang, and solar orientation, in a given time period and the impact of suggested improvements per year.
6. Understand the process of assessing available tax credits from local and central governments for qualifying customers and use of Saving-to-Investment Ratio formula.

Course-specific General Education Knowledge Goals and Core Skills

General Education Knowledge Goals
Goal 1. Communication. Students will communicate effectively in both speech and writing.
Goal 2. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
Goal 3. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
Goal 4. Diversity. Students will understand the importance of a global perspective and culturally diverse peoples.
Goal 5. Ethical Reasoning and Action. Students will understand ethical issues and situations.

MCCC Core Skills
Goal A. Written and Oral Communication in English. Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.
Goal B. Critical Thinking and Problem-solving. Students will use critical thinking and problem solving skills in analyzing information.
Goal C. Ethical Decision-Making. Students will recognize, analyze and assess ethical issues and situations.
Goal D. Information Literacy. Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.
Goal E. Computer Literacy. Students will use computers to access, analyze or present information, solve problems, and communicate with others.
Goal F. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.

Units of study in detail.

Unit I  [Energy Principles - concepts, terms and definitions]

Learning Objectives:
The student will be able to…

- Define energy in terms of laws of thermodynamics, temperature and heat, sensible and latent heat, Heat and work, energy vs. power and pressure vs. flow. (Course Competencies 1,3 & 4; Gen Ed Goals 2 & 3; Core Skills A, B & D.)
- Understand concepts of energy transformation and heat flow. (Course Competencies 1; Gen Ed Goals 2 & 3; Core Skills A, B & D.)
- Define principles of energy, comfort, climate, temperature and humidity. (Course Competencies 1; Gen Ed Goals 2 & 3; Core Skills A, B, &D.)
- Comprehend concepts of converting energy for home use in terms of: combustion heating, electric resistance heating, refrigeration cycle and lighting. (Course Competencies 1; Gen Ed Goals 2 & 3; Core Skills A, B, &D.)
Unit II  [The Energy Auditing Process - energy auditing, services rendered]

Learning Objectives:
The student will be able to…

- Be capable of identifying the purpose of an energy audit. (Course Competencies 1 & 2; Gen Ed Goals 2 & 3; Core Skills A, B, & D.)
- Identify and explain screening and surveying. (Course Competencies 2 & 5; Gen Ed Goals 1, 2, 3 & 5; Core Skills A, D & F.)
- Identify and explain the visual inspection process. (Course Competencies 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
- Identify and explain the diagnostic testing and numerical analysis services that compose energy audits. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
- Analysis existing energy uses: electricity, natural gas, fuel oil, or other energy sources consumed. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
- Understand concepts of energy usage, base load vs. seasonal, energy indexes, electricity peak load, and carbon footprint. (Course Competencies 1, 2, 3 & 4; Gen Ed Goals 2 & 3; Core Skills A, B & D.)
- Understand the process of work scope and contracts, work inspections, in progress inspections, final inspections, quality insurance, and energy auditing bias and ethics and customers relations. (Course Competencies 1, 2, 3 & 4; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)

Unit III  [Building Envelope and Components – solving associated problems with building shell]

Learning Objectives:
The student will be able to…

- Record various characteristics of building envelope including: walls, ceilings, floors, doors, windows, skylights. (Course Competencies 1, 2, 3, 4 & 5; Gen Ed Goals 1 & 3; Core Skills A, B & D.)
- Measure and estimate area and resistance to heat flow (R-Value), (U-Value) for each component of building. (Course Competencies 4 & 5; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Solve for infiltration. (Course Competencies 1 & 4; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Explain concepts of energy management, within the context of building envelope. (Course Competencies 1 & 6; Gen Ed Goals 2 & 3; Core Skills A, B & D.)

Unit IV  [Heating Systems – different systems, their components and energy guidelines]

Learning Objectives:
The student will be able to…

- Understand the combustion process, burners, draft and how different heating units consume energy. (Course Competencies 1 & 4; Gen Ed Goals 1, 2 & 3; Core Skills A, B, E & D.)
- Identify system components such as, chimneys, liners and vents and their functions. (Course Competencies 1 & 4; Gen Ed Goals 1, 2 & 3; Core Skills A, B, E & D.)
- Explain the distribution system. (Course Competencies 1 & 5; Gen Ed Goals 2 & 3; Core Skills A, B & D.)
- Understand types of efficiencies and how heating systems create energy loss. (Course Competencies 1 & 4; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Identify pattern and energy use behavior and building consumption in regards to heating systems. (Course Competencies 3 & 4; Gen Ed Goals 3; Core Skills B & D.)
- Assess the physical and programming conditions of building mechanical systems such as: heating, ventilation and thermostats. (Course Competencies 1 & 4; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Explain concepts of energy management, within the context of heating systems. (Course Competencies 1 & 3; Gen Ed Goals 2 & 3; Core Skills B & D.)

ERG-112 – Energy Audit and Weatherization
Unit V  [Air Condition Systems - principles of cooling, various applications it has on building types]

Learning Objectives:
The student will be able to…

- Understand the summer comfort principles. (Course Competencies 1 & 4; Gen Ed Goals 3; Core Skills B & D.)
- Comprehend heat gain, shading, conservation, air leakage and transmission. (Course Competencies 1 & 4; Gen Ed Goals 3; Core Skills B & D.)
- Understand concepts of cooling and ventilation, air movement. (Course Competencies 1, 3 & 4; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Comprehend concepts of air conditioning and types of systems: chillers, electric, gas driven, absorbers and components utilize in cooling. (Course Competencies 1 & 3; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Solve practical load estimating problems. (Course Competencies 4; Gen Ed Goals 2 & 3; Core Skills B.)
- Identify pattern and energy use behavior and building consumption in regards to cooling systems. (Course Competencies 1, 4 & 6; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Assess the efficiency, physical and programming conditions of building mechanical cooling systems. (Course Competencies 1 & 4; Gen Ed Goals 3; Core Skills B.)

Unit VI  [Lighting and Appliances – how lighting and appliances affect energy audit]

Learning Objectives:
The student will be able to…

- Understand concepts of efficacy/efficiency. (Course Competencies 1 & 2; Gen Ed Goals 2 & 3; Core Skills B, D & E.)
- Explain various lighting types, characteristics. (Course Competencies 1; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Explain light quality, light uses, light color – Color Rendering Index (CRI) and controls. (Course Competencies 1 & 2; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Understand appliance energy ratings. (Course Competencies 1 & 5; Gen Ed Goals 2 & 3; Core Skills A, B & D.)
- Define refrigeration energy consumption. (Course Competencies 1; Gen Ed Goals 2 & 3; Core Skills B, D & E.)
- Explain concepts of energy management, within the context of lighting and appliances. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)

Unit VII  [Water Heating / Water Conservation - principles, systems and hot water systems]

Learning Objectives:
The student will be able to…

- Understand principles of water heating, energy use, capacity and efficiencies. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
- Comprehend design types, water storage units and alternatives to storage water heaters. (Course Competencies 1, 2 & 5; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Understand basic principles of maintenance and operations of water heating systems. (Course Competencies 1 & 3; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Explain concepts of energy management, within the context of water heating systems. (Course Competencies 1 & 3; Gen Ed Goals 2 & 3; Core Skills B & D.)
- Understand water conservations methods, leak detection and water audits. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
Learning Objectives:
The student will be able to…

- Be able to conduct energy model study to ASHRAE standard. (Course Competencies 1, 2, 3, 4 & 5; Gen Ed Goals 1, 2, 3 & 5; Core Skills A, B & D.)
- Develop review record drawings – as built. (Course Competencies 1, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B, E & D.)
- Conduct a site visit using acceptable techniques for building type and size. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
- Will create a set of auditor’s floors plans. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2, 3 & 5; Core Skills A, B & D.)
- Identify pattern and energy use behavior and building consumption by customer. (Course Competencies 1, 2, 3, 5 & 6; Gen Ed Goals 1, 2, 3, 4 & 5; Core Skills A, B,C,D, F.)
- Estimate energy use given local climate criteria, thermostat setting, roof overhang, and solar orientation, in a given time period and the impact of suggested improvements. (Course Competencies 1, 2, 3, 4 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)
- Comprehend the process of assessing available tax credits from local and central governments for qualifying customers and use of Saving-to-Investment Ratio formula. (Course Competencies 1, 2, 3 & 5; Gen Ed Goals 1, 2 & 3; Core Skills A, B & D.)

Method of Instruction:
Lecture will be used as the primary method of information delivery. PowerPoint slide presentations explaining theories and working examples will form the base from which numerous homework problems and lab exercises to yield student proficiency. The lecture, problems, and laboratory work will emphasize the practical application of theories and formula. The laboratory work will follow the lecture as close as practicable. Experiment will emphasize and reinforce the theories discussed in the classroom and will yield much practical experience in using flow measuring devices and constructing proper circuits to obtain correct measurements with these devices.

Homework will be assigned each week and it will be collected, marked and returned to the students. Practice doing these problems will be essential to obtaining proper understating of the theories expounded and in acquiring a good grade. The homework will appear as an integral part of the final grade. A report will be required for each of the experiment that will be assigned during the semester.

Evaluation of student learning:

a) Exams and Grades: TOTAL

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<tr>
<td>Tests</td>
<td>30%</td>
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<tr>
<td>Papers</td>
<td>20%</td>
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<tr>
<td>Lab Reports and quizzes</td>
<td>20%</td>
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<tr>
<td>Lab Project</td>
<td>10%</td>
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<tr>
<td>Final examination (COMPREHENSIVE)</td>
<td>20%</td>
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b) Attendance:

Students are expected to attend ALL lectures and ALL lab sessions. In addition, punctuality is required. The late arrival of a student causes a disruption to the lecture and discussion, and is therefore unfair to everyone. Repeated absences (in excess of three) may result in a loss of 5 points (5%) from the final grade average.

c) Papers:
There will be two paper assigned during this semester. The assignment will be given on
the first day of class, and the due date will be established at that time. **Papers will never
be accepted late.** The grade for each written assignment will be worth 10% of the
overall course grade.

d) Laboratory:

Students are expected to attend every lab and to maximize use of lab time. Punctuality is
required. A student who arrives late, after the explanation of the day’s procedures has
been given, will not be permitted to stay for lab. This is the only time for “hands on”
experiences which are vital for learning the material presented in the course. **Please
make sure you leave the lab the way you found it – neat and orderly.**

Each Laboratory will require a laboratory report that is due at the beginning of the lab the
following week. Format for these will be discussed in the laboratory.

There will be several laboratory quizzes during the semester, which will be announced
one week in advance. Grades for these laboratory quizzes will be averaged into the total
20% of the Lab Write-up grade. A student who arrives after the lab quiz has been
completed will not be permitted to take the quiz.

A laboratory project will be done in the latter part of the course as shown in the schedule
above. This project is worth 10% of your final grade. You will be given laboratory time to
work on the project, but it is expected that you do additional work outside of the assigned
time. The lab will be open at scheduled times during the semester once the project
begins. Time will be posted on the laboratory door.

e) Comprehensive Final Examination

There will be a final comprehensive examination during the last week. It will cover all of
the material from the semester, and will be worth 20% of the overall course grade. This
exam must be taken when scheduled. **Please note that this exam will not be given
early, so do not make travel or vacation plans that will prevent your being in
Paterson for the exam.**

**Academic Integrity Statement:**

Students are expected to comply with the college-wide requirements for academic integrity. Mercer
County Community College is committed to Academic Integrity—the honest, fair, and continuing pursuit of
knowledge, free from fraud or deception. This implies that students are expected to be responsible for
their own work. Presenting another individual’s work as one’s own and receiving excessive help from
another individual will qualify as a violation of Academic Integrity. The entire policy on Academic Integrity
is located in the Student handbook and is found on the college website
([http://www.mccc.edu/admissions_policies_integrity.shtml](http://www.mccc.edu/admissions_policies_integrity.shtml)).

**Students with Disabilities:**

Any student in this class who has special needs because of a disability is entitled to receive
accommodations. Eligible students at Mercer County Community College are assured services under the
Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973. If you believe you are
eligible for services, please contact Arlene Stinson, the Director of Academic Support Services. Ms.
Stinson’s office is LB221, and she can be reached at (609) 570-3525.
During the first laboratory class your lab instructor will call your attention to the safety procedures to be followed in the Laboratory. Be sure you become familiar with the location and proper use of each of the following basic safety equipment: Fire Extinguishers Room Exits Trash Cans, etc…

The following are the general guidelines and procedures which should be followed during each of your laboratory classes:

- Please be certain to wear gloves as well as safety glasses when appropriate. Please stay alert and attentive during the entire lab class.

- Please be careful not to cut yourself or your partner with any instruments. **Never Cut Toward yourself** and put the instruments down when not in use. Your lab instructor will demonstrate the proper handling and use of any appropriate equipment.

- In the event of a cut or injury of any kind, please notify your laboratory instructor immediately.

- Please be certain to **Wash Your Hands Well** with soap and water prior to leaving the lab for any reason. Also, please do not smoke, eat, drink or bite your nails while in the laboratory.

- Please be certain that you read and understand the details in those sections on preparing for the laboratory, working in the laboratory, and laboratory safety and housekeeping that are included in the required lab manual for the course.

- Please note that although dangerous chemicals may occasionally have to be utilized in our laboratory always read the labels on the containers and follow all of the instructions carefully.

- Please turn off your cell phone before entering the lab.