Course Number & Name: UTI 112 Energy Audit and Weatherization

Credit Hours: 3.0  
Contact Hours: 4.0  
Lecture: 2.0  
Lab: 2.0  
Other: N/A

Prerequisites: Grade of “C” or better in UTI 111

Co-requisites: None  
Concurrent Courses: None

Course Outline Revision Date: Fall 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.

Course Goals: Upon successful completion of this course, students should be able to do the following:

1. explain the basic principles of energy;
2. describe in detail the energy auditing process;
3. identify and explain the necessary assessment tools, energy audit software and procedural concepts used in energy auditing;
4. solve basic heating and cooling load problems, including solving for the R-value and assessing (quantifying) overall building thermal performance; and
5. write an energy audit report estimating energy use given local climate criteria, thermostat setting, roof overhang, and solar orientation given a specific time period and the impact of suggested annual improvements.

Measurable Course Performance Objectives (MPOs): Upon successful completion of this course, students should specifically be able to do the following:

1. Explain the basic principles of energy:
   
   1.1 describe energy, heat flow, thermal comfort, and converting energy for building uses;
   1.2 define energy in terms of the laws of thermodynamics, temperature and heat, sensible and latent heat, heat and work, energy versus power, and pressure versus flow;
   1.3 explain the concepts of energy transformation and heat flow;
   1.4 explain the principles of energy, comfort, climate, temperature and humidity; and
   1.5 explain concepts of converting energy for home use including combustion heating, electric resistance heating, refrigeration cycles and lighting
Measurable Course Performance Objectives (MPOs) (continued):

2. Describe in detail the energy auditing process:
   2.1 identify and describe the purpose of an energy audit;
   2.2 explain screening and surveying;
   2.3 explain the visual inspection process;
   2.4 explain the diagnostic testing and numerical analysis services that compose energy audits;
   2.5 analyze existing energy uses including electricity, natural gas, fuel oil, and/or other energy sources consumed;
   2.6 explain concepts of energy usage, base load versus seasonal, energy indexes, electricity peak load, and carbon footprints; and
   2.7 discuss the process of work scope and contracts, work inspections, in-progress inspections, final inspections, quality insurance, energy auditing bias, ethics, and customers relations

3. Identify and explain the necessary assessment tools, energy audit software and procedural concepts used in energy auditing:
   3.1 identify and record various characteristics of the building envelope including walls, ceilings, floors, doors, windows, and skylights;
   3.2 measure and estimate the area and resistance to heat flow (R-Value), (U-Value) for each component of building;
   3.3 solve for infiltration; and
   3.4 discuss concepts of energy management within the context of the building envelope

4. Solve basic heating and cooling load problems, including solving for the R-value and assessing (quantifying) overall building thermal performance:
   4.1 explain the combustion process, burners, draft and how different heating units consume energy;
   4.2 describe types of efficiencies and explain how heating systems create energy loss;
   4.3 explain the concepts of cooling and ventilation and air movement;
   4.4 describe the various lighting types;
   4.5 explain appliance energy ratings;
   4.6 explain the principles of water heating, energy use, capacity and efficiencies; and
   4.7 discuss water conservation methods, leak detection and water audits

5. Write an energy audit report estimating energy use given local climate criteria, thermostat setting, roof overhang, and solar orientation given a specific time period and the impact of suggested annual improvements:
   5.1 conduct an energy model study to ASHRAE standard;
   5.2 develop, review, and record drawings as built;
   5.3 conduct a site visit using acceptable techniques for determining building type and size;
   5.4 create a set of auditor’s floor plans;
   5.5 identify pattern-and-energy-use behavior and building consumption by customer;
   5.6 estimate energy use given local climate criteria, thermostat setting, roof overhang, and solar orientation given a specific time period and the impact of suggested annual improvements; and
   5.7 explain the process of assessing available tax credits from local and central governments for qualifying customers and the use of the Saving-to-Investment Ratio formula
Methods of Instruction: Instruction will consist of a combination of lectures, class discussions, classroom demonstrations, laboratory experiments, board work, group work, and individual study.

Outcomes Assessment: Quiz, test, and exam questions are blueprinted to course objectives. Checklist rubrics are used to evaluate the lab reports for the presence of course objectives. Data is collected and analyzed to determine the level of student performance on these assessment instruments in regards to meeting course objectives. The results of this data analysis are used to guide necessary pedagogical and/or curricular revisions.

Course Requirements: All students are required to:
1. Maintain regular attendance and participate in classroom discussions.
2. Complete homework assignments and the lab reports.
3. Sit for all quizzes, tests, and exams.
4. Read all assigned textbook pages.

Methods of Evaluation: Final course grades will be computed as follows:

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<tr>
<th>Grading Components</th>
<th>% of final course grade</th>
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<tbody>
<tr>
<td>Homework, Quizzes, Class Participation, and Attendance</td>
<td>20 – 30%</td>
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<tr>
<td>A perusal of homework problems and quizzes and an analysis of class discussion will indicate the extent to which students master course objectives. Attendance may also be counted toward the student’s final course grade.</td>
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<tr>
<td>Laboratory Reports</td>
<td>20 – 25%</td>
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<td>Lab reports will provide evidence that the students have read assigned lab manual sections, can follow written procedures, measure and record data, perform calculations and write reports including all specified components.</td>
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<tr>
<td>3 or more Tests (dates specified by the instructor)</td>
<td>30 – 35%</td>
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<tr>
<td>Tests will show evidence of the extent to which students meet course objectives, including but not limited to identifying and applying concepts, analyzing and solving problems, estimating and interpreting results and stating appropriate conclusions using correct terminology.</td>
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<tr>
<td>Final Exam (comprehensive)</td>
<td>20 – 30%</td>
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<td>The same objectives apply as with tests, but it is anticipated that students will provide increased evidence of synthesizing a combination of concepts.</td>
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Note: The instructor will provide specific weights, which lie in the above-given ranges, for each of the grading components at the beginning of the semester.
**Academic Integrity:** Dishonesty disrupts the search for truth that is inherent in the learning process and so devalues the purpose and the mission of the College. Academic dishonesty includes, but is not limited to, the following:

- plagiarism – the failure to acknowledge another writer’s words or ideas or to give proper credit to sources of information;
- cheating – knowingly obtaining or giving unauthorized information on any test/exam or any other academic assignment;
- interference – any interruption of the academic process that prevents others from the proper engagement in learning or teaching; and
- fraud – any act or instance of willful deceit or trickery.

Violations of academic integrity will be dealt with by imposing appropriate sanctions. Sanctions for acts of academic dishonesty could include the resubmission of an assignment, failure of the test/exam, failure in the course, probation, suspension from the College, and even expulsion from the College.

**Student Code of Conduct:** All students are expected to conduct themselves as responsible and considerate adults who respect the rights of others. Disruptive behavior will not be tolerated. All students are also expected to attend and be on time for all class meetings. No cell phones or similar electronic devices are permitted in class. Please refer to the Essex County College student handbook, *Lifeline*, for more specific information about the College’s Code of Conduct and attendance requirements.
**Course Content Outline:** based on the text *Saturn Energy Auditor Field Guide* by Krigger and Dorsi; published by Saturn Resource Management, Inc, 2009; ISBN #: 013512543X

<table>
<thead>
<tr>
<th>Week</th>
<th>Content/Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to the course; Understanding energy usage (ch 1); Energy auditing process, work inspections (ch 1)</td>
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</table>
| 2    | Customer relations, customer education (ch 1)  
Lab #1: Energy Efficiency |
| 3    | Infrared scanning (ch 2); **Test 1**; Attic ventilation, roof insulation (ch 2) |
| 4    | Thermal boundary decisions (ch 2); Air-leakage problems and solutions (ch 3) |
| 5    | Air-leakage testing (ch 3); Air-barrier zone pressure diagnosis (ch 3) |
| 6    | Lab #2: Blower-Door Testing  
Heating system replacement (ch 4); **Test 2** |
| 7    | Testing gas furnaces and boilers, inspecting gas combustion systems (ch 4); Air conditioning systems, summer comfort principles (ch 4) |
| 8    | Heat gain, shading, conservation, air leakage and transmission (ch 4); Types of air conditioning systems: chillers, electric, and absorbers (ch 4) |
| 9    | Lab #3: Evaluating Heating Systems  
Water heating/water conservation (ch 5) |
| 10   | Water conservation methods, leak detection and water audits (ch 5); Lighting and appliances (ch 5) |
| 11   | Efficacy/efficiency and color rendering index (CRI)  
Lab #4: Refrigerator Evaluation |
| 12   | Window shading, exterior storm doors (ch 6); **Test 3**; Exterior insulation and siding (ch 6) |
| 13   | Pollutant source control (ch 7); Electrical safety, ASHRAE standards (ch 7) |
| 14   | Energy audit report, site visit, tax credits, saving-to-investment ratio formula; Develop a written energy audit report |
| 15   | **Final Exam** |