

Building Energy Efficiency Syllabus



DEPARTMENT OF APPLIED COMPUTING AND ENGINEERING
TECHNOLOGY ENERGY TECHNOLOGY PROGRAM

COURSE INFORMATION

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| Credits | 4 |

Prerequisites: NRGY 101

Familiarity with general energy terminology and units of measurement and basic knowledge of residential construction principles and terminology is assumed, and will be useful though not required. Students must possess basic word processing skills, be able to download and open relatively large PDF files, and perform functions such as loading software and navigating between folders and files. Familiarity with basic computing skills is a must for online courses and will significantly influence your course experience.

DESCRIPTION

This course provides an overview of energy efficiency concepts in residential and commercial buildings including design and construction fundamentals, passive and active systems (e.g. HVAC), efficiency improvement opportunities, auditing and analysis techniques, certifications and standards, building commissioning, and operation and maintenance (O&M) concepts. The discussion of residential energy efficiency will include an emphasis on the Passivhaus standard. A broad overview of building technician certifications including prepping for the RESNET Home Energy Rating System (HERS) rater and Building Performance Institute (BPI) Infiltration and Duct Leakage (IDL) Certification exams is included. Local building tours and hands-on exposure to HVAC systems, controls and maintenance are also offered. Analysis techniques used for quantifying reduction of energy consumption and energy management, including energy accounting and energy auditing will be covered. Energy modeling tools and concepts will be introduced. Career opportunities in energy efficiency will be discussed.

OVERVIEW

Reducing energy consumption through energy efficiency can have immediate effects on the operational energy costs and environmental impacts of new and existing homes and commercial buildings. Efficiency improvements are generally recognized as the most cost-effective means of meeting future energy needs in an increasingly carbon constrained world. With rising energy supply costs and growing concerns surrounding global climate change, professional opportunities in energy efficiency will grow dramatically in the future.

This course will focus on residential buildings and cover some of the materials used in the RESNET Home Energy Rater training course. A focused effort will be made to prepare students to take the BPI IDL Certification exam if they so desire. We will utilize Residential Energy as our primary text book. Residential Energy deals largely with existing homes, but the concepts are applicable to both new and existing homes, and commercial buildings. Building envelope and duct tightness testing



are fundamental elements of building energy efficiency and an overview of both will be covered.

Familiarity with general residential construction techniques and terminology will be very helpful to students. If you are not up to speed on residential construction, the course is still doable, but will require a willingness to seek out additional clarifying information on your own as needed. See the Additional References section below for a few residential building related resources.

COURSE OBJECTIVES

At the completion of this course students should be able to:

- 1) Understand and apply fundamental concepts of energy and utilities as related to the built environment: Heat Transfer, Fluid Mechanics, Moisture Control, Ventilation and Indoor Environmental Quality (IEQ) Control, Energy Efficiency
- 2) Communicate the potential of building energy efficiency to impact the nation's energy future, especially as it applies to climate change
- 3) Describe the objectives and general framework of building energy efficiency standards such as the ENERGY STAR for Homes Program
- 4) Become familiar with Passivhaus standards
- 5) Describe the objectives and procedures of energy and IEQ focused ratings systems such as the Home Energy Rating System
- 6) Feel prepared to take the BPI Infiltration and Duct Leakage (IDL) Certification exam, with some additional self-directed preparation as needed
- 7) Perform basic heat transfer and load calculations as they relate to the built environment
- 8) Describe building tightness testing procedures using a blower door
- 9) Describe duct tightness testing procedures using a duct blaster or other industry standard means
- 10) Identify mechanical ventilation issues and improvement opportunities in buildings
- 11) Gain hands-on experience with HVAC controls and maintenance
- 12) Communicate the energy implications of various HVAC and water heating systems
- 13) Identify the objectives and challenges in designing and building highly efficient or zero energy buildings
- 14) Explain the approaches of the two primary national residential green building programs (LEED for Homes and NAHB Green Building Standard) in their treatment of energy efficiency

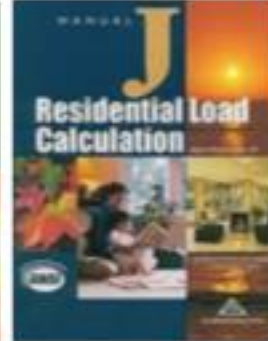
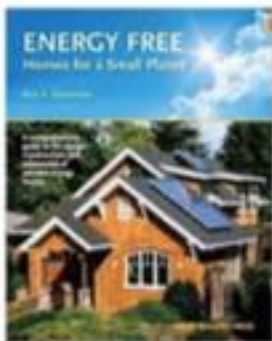
REQUIRED TEXTS/MATERIALS



1. *Residential Energy: Cost Savings and Comfort for Existing Buildings* by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013 (www.srmi.biz). This book is now in its 6th edition. The majority of readings for the course will come from this text.

OPTIONAL TEXTS

1. *Energy Free: Homes for a Small Planet* by Edminster
2. *2009 Home Builder's Jobsite Codes* by van Note
3. *Handbook of Energy Audits* 9th Ed. Al Thurman et al.
4. *Manual J* Heating and Load Calculation



MORE SPECIALIZED TEXTBOOKS

1. *ASTM E1554-07* Duct Leakage and blower door testing application standard, and basis for the BPI IDL exam
2. *ASHRAE Standard 90.1* Recommended study guide for HERS rater
3. *ASHRAE Standard 62.1 & 62.2* Recommended study guide for HERS rater





OPTIONAL REFERENCES

Familiarity with residential construction and building systems will be useful. If you are unfamiliar with residential construction terms, I would recommend reviewing a residential construction and building reference such as those identified below, and/or making use of Google for clarification of unknown terms and concepts throughout the semester. The references below are available from online retailers and are reasonably priced if purchased used. The books listed below cover far more than is needed for the purposes of this class.

The following three books are detailed references for building construction:

[Carpentry & Building Construction](#) by Mark and John Feirer

[Carpentry & Construction](#) by Mark Miller

[Carpentry & Building Construction: A Do-It-Yourself Guide](#) by William P. Spence

The following book is an excellent introduction to foundations and framing:

[Graphic Guide to Frame Construction](#) (For Pros By Pros) by Rob Thallon

REQUIRED LABORATORY SUPPLIES

For your laboratory experiment, you must have a means of measuring and recording two temperatures simultaneously. Equipment options will be discussed in class with sufficient time to purchase prior to required use.

COMPUTER HARDWARE AND SOFTWARE

The information for this course is presented in several formats. The student must be able to open and read Microsoft Word as well as PDF files. Numerous web site references will be used. Since several of the documents that will be used in this course are relatively large PDF files, ***the speed of your computer and of your Internet access will impact your online experience.***

If you have problems accessing course material, your browser may very well be the culprit. Because I will need to reset Test and Quiz access, please contact me directly if you have a technical problem while taking a Quiz or Test (See the Technical Glitches section under the Assessment/Grading Policies heading below for details). UM online Tech Support can be reached from the "Tech Support" tab in the Main Menu on Blackboard, or by calling 243-HELP (4357).

ASSESSMENT/GRADING POLICIES

There will be 13 Learning Unit Quizzes worth 1/4 of your final grade. There will be one Special Assignment or Field Experiment worth 1/4th of your grade. Discussion Board Forum posts will be required in some Learning Units, but not all. There will be two exams each worth 1/4 of your final grade. All Learning Unit Quizzes, the Mid-term and the Final Exam will be open book. Learning Unit Quiz questions will come from the PDF lecture and/or the assigned readings from that Learning Unit. Mid-term and Final Exams will consist of roughly 70 multiple choice or true/false questions. You will only be able to access Quizzes and Exams once, so once you start a Quiz or Exam, you must complete and submit it. It is possible and acceptable to have access to course



materials contained in the Learning Units while taking Exams and Quizzes. This is best achieved by opening additional browser windows and navigating between browser windows to find relevant materials **without closing the Exam or Quiz window**.

Approximate grade distribution will be as follows: 90-100%=A, 80-90%=B, 70-80%=C, 60-70%=D, below 60% will be an F.

GRADING SUMMARY

25%- Learning Unit Quizzes

25%- Special Assignment or Experimental Write Up

25%- Mid-Term Exam

25%- Final Exam

LATE WORK

Late assignments and missed Quizzes or Exams will receive a score of zero. If you have an extenuating circumstance that will prohibit you from meeting a deadline, please contact me well in advance of the deadline and I will make reasonable accommodations.

TECHNICAL GLITCHES

If you encounter a technical problem that prohibits you from completing a Quiz or Test, please e-mail me immediately with details of the problem. We will work with Technical Support to resolve the problem as expeditiously as possible. You will not be penalized in any way for technical problems with Moodle, or technical failings that the fault of the instructor.

HOMEWORK

The weekly Learning Unit contents will be made available at 8 AM (Mountain Time) on the Monday of that week's Learning Unit. Quizzes will be available from within each Learning Unit. You are to complete the Quiz and click on the "Submit" button by 11:55 PM (Mountain Time) on the Sunday of the week in which that Learning Unit is scheduled. Correct Quiz answers will be posted within that Learning Unit on the following Monday.

P/NP option: A student must earn the equivalent of a letter grade of A, B, or C for a P.

Online support may be obtained via courseware-support@umontana.edu or x4999

TOPICAL OUTLINE

Each Learning Unit will include a summary of the week's assignments and a PowerPoint "lecture" that has been converted to a PDF (for compatibility reasons). Assigned readings will be in the text book, PDF files imbedded in the learning unit, and in documents available on the Internet. The length of the PDF lecture will vary depending on how well that topic is covered by the textbook and supplemental reading sources. There are thirteen Learning Units. There will be no Learning Unit the week of the Mid-term Exam.



Weekly Topic Outline

- Week 1: LU#1- Class Introductions and Outline
- Week 2: LU#2- Introduction to Built Environment and Energy Efficiency
- Week 3: LU#3- Introduction to Codes, Standards, Rating Systems
- Week 4: LU#4- Introduction to Efficiency Auditing and Modeling Concepts and Tools
- Week 5: LU#5- Energy Fundamentals 1 – Physics and Heat Transfer
- Week 6: LU#6- Energy Fundamentals 2 – Fluid Mechanics (Air and Water)
- Week 7: LU#7- Energy Fundamentals 3 – Moisture Control
- Week 8: LU#8- Space Heating, Cooling, & Ventilation – Load Calcs and IEQ
- Week 9: *Mid-term Week*
- Week 10: LU#9- Performance Concepts: Envelope and Ventilation
- Week 11: LU#10- Performance Testing: Blower Door and Duct Leakage
- Week 12: LU#11- HVAC Systems and Controls Overview
- Week 13: LU#12- Renewable Energy, Zero Energy Homes (Passivhaus)
- Week 14: LU#13- Commissioning (Cx), Operation and Maintenance (O&M), and Course Review
- Week 15: *Finals Week*

DISABILITY ACCOMMODATIONS POLICY

Students with disabilities may request reasonable modifications by contacting me. The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. “Reasonable” means the University permits no fundamental alterations of academic standards or retroactive modifications.

