1-2015

NRGY 235.01M: Building Energy Efficiency

Alexander J. Sievers
University of Montana - Missoula, zandy.sievers@mso.umt.edu

Lagan M. Todd
University of Montana - Missoula, lagan.todd@mso.umt.edu

MISSOULA COLLEGE
UNIVERSITY OF MONTANA

Building Energy Efficiency
Syllabus

Course number:	NRGY 235
Credits:	3
Instructors:	Bradley Layton, Zandy Sievers, and Lagan Todd (input from John Freer)
Course Format:	Online with Face-to-face recording sessions in AD11 WF 3:10pm-5:00pm Three to four field trips will be provided for local students and recorded for online students.
Office hours:	**WF** 1:30 – 3:00pm in Griz House 8, Office D (GH8-D)
Contact:	(406) 234-7865 lagan.todd@umontana.edu; zandy.sievers@umontana.edu
Final:	Online during Finals Week or F2F by appointment

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.

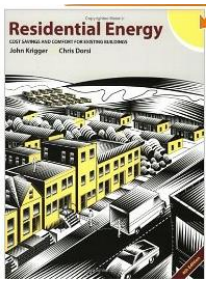
Familiarity with general residential construction techniques and terminology will be very helpful to students. If you are not up to speed on residential construction, the course is still doable, but will require a willingness to seek out additional clarifying information on your own as needed. See the 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 rating 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 the NAHB Green Building Standard) in their treatment of energy efficiency.

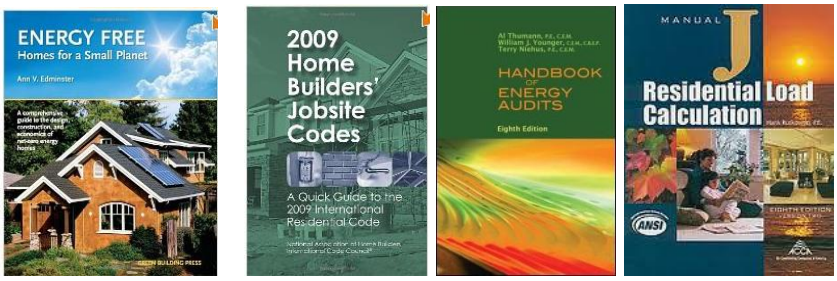
Required Texts/Materials:

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 the readings for the course will come from this text.



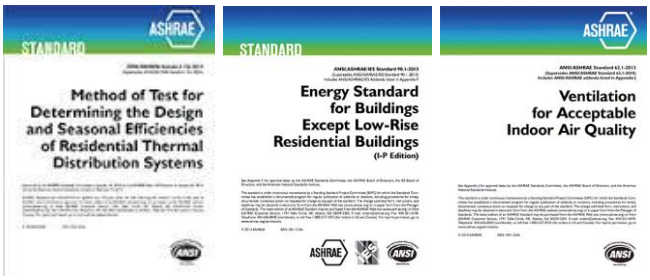
Optional Textbooks:

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. If the book is not in stock at the MC-UM Bookstore, you can order through www.montanabookstore.com. It is also available from major online vendors such as Amazon.com. It is an excellent overview of energy issues and potential savings in homes. This text is used nationally in many Home Energy Rater training and certification courses.
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 Adobe 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 (Subject to Minor Adjustments)

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*
Spring Break
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*

For a list of specific dates for this semester, see the Provost's calendar.

Drop/Add Policy:
Refer to: http://www.umt.edu/catalog/policy_procedure.htm

Academic Honesty Policy:
All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/SA/VPSA/index.cfm?page?1321.

Students with Disabilities:
Students with disabilities will receive reasonable accommodations in this online course. To request course modifications, please contact me as soon as possible. I will work with you and Disability Services in the accommodation process. For more information, visit the Disability Services website at http://www.umt.edu/dss/ or call 406.243.2243 (Voice/Text).

E-mail Policy at UM:
According to the University e-mail policy, an "employee must use *only* UM assigned student e-mail accounts for all e-mail exchanges with students, since such communication typically involves private student information." This means that **you *must* send any correspondence through your UMConnect account. For more information on setting up and using your UMConnect account, please go to *http://www.umt.edu/it/email/studentemail.htm*.**