

# Course Schedule

## Building Energy Efficiency



### Welcome and Class Introduction

### Forum Prompt/Statement

- What is the topic of your NRGY235 class projects and how are you going to accomplish your objectives?
- You should be aware that 25% of your grade for the course is based upon a single course assignment to be turned in prior to the finals week.

You will need to design your own assignment plan, I'd like to get the ball rolling on that as soon as we can.

The expectations will be as follow:

- Each assignment should require about 20 hours of your time.
- The deliverable for each assignment will be a report of 3 to 5 pages of narrative, along with any photos, data tables, etc. (you will not be penalized for longer reports, and it is expected that if your particular assignment and report includes photos then your report may run longer in total)

Here are some suggested assignments, but we are open to discussing any custom assignment plans that you would like to design. We would like to provide verbal/email approval based on your plan if you intend to go the custom route.

1) Create an energy model of a building using eQuest, EnergyPlus, REM/Rate or some other acceptable software. The report will detail your methods, process and will include energy usage reports from the model. Consider including parametric runs of energy conservation measures as part of the modeling assignment.

2) Complete an energy efficiency audit of your home, or a friend's home. The resulting report should provide a facility description, a listing of feasible Facility Improvement Measures (FIM) (e.g. Add insulation to attic, Replace existing non-programmable thermostat with a programmable thermostat and implement night setback, etc.), and Rough Order of Magnitude estimates of cost, savings and payback for each FIM.

3) A research paper on a building efficiency related topic of your choosing.

4) Take appropriate measurements on any building system (to which you have access; e.g. your own furnace) to be able to report energy and power into the system, and useful energy and power out of the system, and to calculate an efficiency rating for the system. The report will be in the form of a scientific paper presenting your hypothesis, methodology, and results, including raw data and data analysis.

5) Create a design of a Net Zero building. You don't have to provide scaled drawings, but you will need to provide schematic design drawings (hand drawings or electronic are okay), a narrative description of the design, and some analysis to show that the building may be able to operate in the specified climate with zero net energy consumption.



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<p><b>Week 1: Course Introduction</b></p>	<p><b>Lectures</b></p> <p>Lecture 1 Part 1: <a href="https://www.youtube.com/watch?v=NZ3laEOnDC8">https://www.youtube.com/watch?v=NZ3laEOnDC8</a>            Lecture 1 Part 2: <a href="https://www.youtube.com/watch?v=BikA-s87zCg">https://www.youtube.com/watch?v=BikA-s87zCg</a>            Lecture 2 Part 1: <a href="https://www.youtube.com/watch?v=k1_5XeqrZkk&amp;feature=youtu.be">https://www.youtube.com/watch?v=k1_5XeqrZkk&amp;feature=youtu.be</a>            Lecture 2 Part 2: <a href="https://www.youtube.com/watch?v=xQSPVOpvY7w&amp;feature=youtu.be">https://www.youtube.com/watch?v=xQSPVOpvY7w&amp;feature=youtu.be</a>            Lecture 2 Part 3: <a href="https://www.youtube.com/watch?v=oi78_UkzyoA&amp;feature=youtu.be">https://www.youtube.com/watch?v=oi78_UkzyoA&amp;feature=youtu.be</a></p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 1 Quiz</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ EIA Colorado State Energy Fact Sheet from RECs</li> </ul>
<p><b>Week 2: Intro to Built Environment and Energy Efficiency</b></p>	<p><b>Reading Assignment</b></p> <ul style="list-style-type: none"> <li>■ MT Res Code Energy.Notes_REDID_Dec 2014</li> <li>■ MT DEQ Brochure EnergyCodeGuideChecklist</li> <li>■ NC2009 Checklist</li> </ul> <p>All readings should be done with the intent of retaining the high-level concepts. There is no need to memorize any numbers or code requirements, etc. at this time. There may be quiz questions related to these, but as always, you can refer to the documents while taking the quiz (quizzes are open-book).</p> <p><b>Lectures</b></p> <p>Lecture 3 Part 1: <a href="https://www.youtube.com/watch?v=zcgJahvfAos">https://www.youtube.com/watch?v=zcgJahvfAos</a>            Lecture 3 Part 2: <a href="https://www.youtube.com/watch?v=0kg6e8AYVgY">https://www.youtube.com/watch?v=0kg6e8AYVgY</a>            Lecture 4 Part 1: <a href="https://www.youtube.com/watch?v=1UnPX6EylA0&amp;feature=youtu.be">https://www.youtube.com/watch?v=1UnPX6EylA0&amp;feature=youtu.be</a>            Lecture 4 Part 2: <a href="https://www.youtube.com/watch?v=pg8_aujeEDE&amp;feature=youtu.be">https://www.youtube.com/watch?v=pg8_aujeEDE&amp;feature=youtu.be</a></p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 2 Quiz</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ MT DEQ Brochure</li> <li>■ MT Res Code Energy Notes</li> <li>■ NC2009 Checklist</li> </ul>



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<p><b>Week 3: Intro to Codes, Standards, and Rating Systems</b></p>	<p><b>Reading Assignment</b> Chapter 1 of Saturn Energy Auditor Field Guide</p> <p><b>Lectures</b> Lecture 5 Part 1 – Building Codes &amp; Standards Lecture 5 part 2 – Montana Energy Code Changes for 2015 Lecture 6 – Sustainable Building Rating Systems</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 3 Quiz</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ 235_Saturn Energy Auditor Ch 1</li> </ul>
<p><b>Week 4: Intro to Energy/Efficiency Auditing and Energy Modeling</b></p>	<p><b>Reading Assignment</b> Residential Energy Chapter 1 – Principles of Energy Chapter 4 – Insulation (skip sections on Facings and Barriers pages 114 - 116)</p> <p><b>Lectures</b> Lecture 7 – Energy Conservation Measures Lecture 8 – Energy Modeling</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 4 Quiz</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ SB Modeling Software Presentation</li> <li>■ Pump Coupler Fail Image</li> <li>■ Missoula College Preliminary Energy Analysis</li> </ul>
<p><b>Week 5: Energy Fundamentals 1 – Physics and</b></p>	<p><b>Reading Assignment</b> Residential Energy Chapter 3 – Air Leakage pages 77 – 81 Chapter 6 – Heating pages 161 - 173</p>



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<b>Heat Transfer</b>	<p><b>Lectures</b></p> <p>Lecture 9 – Physics and Heat Transfer – Practical Applications Lecture 10 – Physics and Heat Transfer</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"><li>■ Week 5 Quiz</li></ul>
<b>Week 6: Energy Fundamentals 2 – Fluid Mechanics</b>	<p><b>Reading Assignment</b></p> <p>Residential Energy Chapter 4 – Insulation; sections on Facings and Barriers (pages 114 to 116) Chapter 10 – Health and Safety</p> <p><b>Lectures</b></p> <p>Lecture 11 – Fluid Mechanics Applications Lecture 12 Part 1 - <a href="https://www.youtube.com/watch?v=mjRQFs8Z4x0&amp;feature=youtu.be">https://www.youtube.com/watch?v=mjRQFs8Z4x0&amp;feature=youtu.be</a> Lecture 12 Part 2 - <a href="https://www.youtube.com/watch?v=-YmZ1Qz1pnA&amp;feature=youtu.be">https://www.youtube.com/watch?v=-YmZ1Qz1pnA&amp;feature=youtu.be</a> Lecture 12 Part 3 - <a href="https://www.youtube.com/watch?v=sr-Gq_nnYWY&amp;feature=youtu.be">https://www.youtube.com/watch?v=sr-Gq_nnYWY&amp;feature=youtu.be</a></p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"><li>■ Week 6 Quiz</li></ul>



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<p><b>Week 7: Energy Fundamentals 3 – Moisture Control</b></p>	<p><b>Reading Assignment</b></p> <p>Residential Energy          Chapter 6 – Heating sections not previously read in Week 5 Reading Assignment (pages 141 to 161, and 174 – 184)          Chapter 8 - Cooling</p> <p><b>Lectures</b></p> <p>Lecture 13 – Moisture Control Applications          Lecture 14 – Moisture Control</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 7 Quiz</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ NRGY 215 Sp 15 Wall Assembly Temp Profile Calculation Spreadsheet</li> </ul>
<p><b>Week 8: IEQ, HVAC, and Load Calcs</b></p>	<p><b>Lectures</b></p> <p>Lecture 15 – Indoor Environmental Quality          Lecture 16 - Pre-Mid-Term Quiz Review, HVAC Heating and Cooling          First Half Quiz Review</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 8 Quiz</li> </ul>
<p><b>Week 9: Midterm</b></p>	<p><b>Reading Assignment</b></p> <p>Residential Energy          Chapter 3 – Air Leakage sections not previously assigned (Pages 82 – 100)          Chapter 5 – Windows and Doors</p> <p><b>Lectures</b></p> <p>Midterm Review</p>



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<p><b>Week 10:</b> <b>Performance Concepts: Envelope &amp; Ventilation</b></p>	<p><b>Reading Assignment</b> ASTM Standard E1554-07</p> <p><b>Lectures</b> Lecture 17 – Envelope and Blower Door Testing Lecture 18 – Duct Leakage Testing</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Week 7 Quiz</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ Thermal Bypass Checklist Guide File</li> <li>■ BPI Infiltration and Duct Leakage Certification Scheme Handbook File</li> <li>■ ASTM E 1554 Annotated File</li> <li>■ ASTM E 1554 Revised Schematics File</li> <li>■ Minneapolis Blower Door Video 1: <a href="https://www.youtube.com/watch?v=67v_rTaZmOA&amp;feature=youtu.be">https://www.youtube.com/watch?v=67v_rTaZmOA&amp;feature=youtu.be</a></li> <li>■ Minneapolis Blower Door Video 2: <a href="https://www.youtube.com/watch?v=x-RKcXwB8bQ&amp;feature=youtu.be">https://www.youtube.com/watch?v=x-RKcXwB8bQ&amp;feature=youtu.be</a></li> </ul>
<p><b>Week 11:</b> <b>Performance Blower Testing – Blower Door and Duct Leakage</b></p>	<p><b>Reading Assignment</b> Residential Energy Chapter 7 – Lighting and Appliances Chapter 9 – Water Heating</p> <p><b>Lectures</b> None – Blower Door Testing Field Day</p> <p><b>Assignments/Activities</b></p> <ul style="list-style-type: none"> <li>■ Blower Door Testing Field Day</li> </ul> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"> <li>■ Blower Door Test Part 1 URL - <a href="https://www.youtube.com/watch?v=n2u3KXV4spU&amp;feature=youtu.be">https://www.youtube.com/watch?v=n2u3KXV4spU&amp;feature=youtu.be</a></li> </ul>



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<b>Week 12: Renewable Energy Systems, Ultra High Efficiency &amp; Zero-Energy Buildings</b>	<p><b>Reading Assignment</b> Articles and links from Reference Materials on Passive House and NXE Buildings.</p> <p><b>Lectures</b> Lecture 19 – Renewables Lecture 20 – Ultra High Efficiency</p> <p><b>Assignments/Activities</b> ■ Week 12 Quiz</p> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"><li>■ Fine Homebuilding Passive House</li><li>■ Passivhaus Designers Guide</li><li>■ Passive House Brochure: <a href="http://www.passivehouse-international.org/upload/ipha-brochure/">http://www.passivehouse-international.org/upload/ipha-brochure/</a></li><li>■ WBDG Net Zero Energy Buildings: <a href="http://www.wbdg.org/resources/netzeroenergybuildings.php">http://www.wbdg.org/resources/netzeroenergybuildings.php</a></li></ul>
<b>Week 13: HVAC Systems and Controls</b>	<p><b>Reading Assignment</b> Articles and links from Reference Materials</p> <p><b>Lectures</b> Lecture 21 – HVAC Systems Lecture 22 - Controls</p> <p><b>Assignments/Activities</b> ■ Week 13 Quiz</p> <p><b>Reference Materials</b></p> <ul style="list-style-type: none"><li>■ Commercial Plant Systems Photos</li><li>■ The Perfect HVAC</li><li>■ BCA Web Page Re: Building Commissioning: <a href="http://www.bcxa.org/essential-attributes-of-building-commissioning/">http://www.bcxa.org/essential-attributes-of-building-commissioning/</a></li></ul>



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<b>Week 14: Commissioning, O&amp;M, Course Review</b>	<b>Lectures</b> Building Commissioning Final Review (not included)
<b>Week 15: Finals</b>	<b>Final Paper Materials</b> Final Paper Template  <b>Assignments/Activities</b> <ul style="list-style-type: none"><li>■ Final Exam</li></ul>

