Weatherization and Energy Efficiency Overview

Description:

This program has been designed for technicians involved in the field of building performance and energy efficiency, who have a certain amount of experience in the field and need subject specific training to enhance their expertise or procure a certification. This structure would provide subject specific courses that are suited for continuing education, test preparation, and career enhancement.

For individuals with no prior experience (either professional or academic) would need to register all prerequisites as defined in each of the certificates.

This unit will prepare you to apply for the following certification(s):

1. BPI Building Analyst Professional
2. LEED for Homes Green Rater
3. BPI Air Conditioning and Heat Pump Professional
4. BPI-104 Envelope

Building Analyst Professional; Homes Green Rater		
MODULE	TOPIC	CREDIT HOURS
CORE COURSES		
1	Building Science*	**3**
2	Thermodynamics and HVAC Systems*	**2**
3	Codes and Certification (I)*	**2**
4	Internal loads, Base Loads and Water Heating*	**2**
5	Building Energy Simulation (I)*	**3**
ADVANCED COURSES	**Subtotal**	**12**
6	Building Diagnostics	**3**
7	Ventilation and IAQ	**3**
8	Energy Efficient Design: Construction and Retrofit (*Envelope System)*	**3**
9	Weatherization Demonstration	**2**
10	Inspection Protocol	**1**
ELECTIVE COURSES	**Subtotal**	**12**
11	Applied Project	**6**
	Total	**30**

Air Conditioning and Heat Pump Professional		
MODULE	TOPIC	CREDIT HOURS
PREREQUISITES		
1	Building Science*	**3**
2	Thermodynamics and HVAC Systems*	**2**
3	Codes and Certification (I)*	**2**
CORE COURSES	**Subtotal**	**7**
6	Building Diagnostics	**3**
7	Ventilation and IAQ	**3**
9	Weatherization Demonstration	**2**
10	Inspection Protocol	**1**
ELECTIVES	**Subtotal**	**9**
4	Internal loads, Base Loads and Water Heating*	**2**
5	Building Simulation	**3**
8	Energy Efficient Design: Construction and Retrofit (Envelope Systems)	**3**
11	Applied Project	**6**
	Total	**30**

Envelope Professional		
MODULE	TOPIC	CREDIT HOURS
PREREQUISITES		
1	Building Science*	**3**
2	Thermodynamics and HVAC Systems*	**2**
3	Codes and Certification (I)*	**2**
REQUIRED CORE COURSES		**7**
6	Building Diagnostics	**3**
7	Ventilation and IAQ	**3**
8	Energy Efficient Design: Construction and Retrofit (Envelope Systems)	**3**
9	Weatherization Demonstration	**2**
10	Inspection Protocol	**1**
ELECTIVES		**12**
4	Internal loads, Base Loads and Water Heating*	**2**
5	Building Simulation	**3**
11	Applied Project	**6**
	Total	**30**

* *This course has a prerequisite, co-requisite, or recommendation. See course description section.*

** *Recommended for tech prep credit.*

Note:

"Credit Hours" refers to this class being conducted at a college or community college. Each credit hour represents 16 in-class hours or one hour of class time each week for 16 weeks.

Academic Options:

Continue your studies by completing the Renewable Energy AAS Degree.

Credits:

- ✓ Material developed by Greenstreet
- ✓ Modified and updated by Samuel Breedlove, Heidi Vasiloff P.C.

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Module 1: Building Science

Description:

This course introduces the fundamentals of buildings science, various aspects of energy efficiency and integrated design. It provides a comprehensive overview of the different systems and technologies and introduce the cutting edge innovations in building practices.

Certification(s):

See Unit Overview for Listings

Prerequisite: None

Required Materials: None

Credit Hours: 3

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss the fundamentals of building science.
2. Be well aware of different active and passive system types.
3. Identify appropriate energy efficient design strategies as a response to different climatic conditions.
4. Enlist various construction materials (innovative materials such as straw bale, SIP) and their application.
5. Discuss effectiveness of traditional construction technologies versus new construction technologies.
6. Effective use the psychrometric chart for thermal comfort calculations.
7. Discuss various ventilation strategies.
8. Perform basic daylighting calculations and simulations.
9. Identify energy efficient design strategies in buildings and critique the same.

Module1: Building Science Outline		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Basics of Building Science	
2	Active and Passive Systems – Direct Heat Gain – Indirect Heat Gain – Trombe Wall – Site Orientation – Shading – Innovative HVAC Systems: • Ground Source Heat Pump • Absorption Cooling	
3	Climate Responsive Design	
4	Materials: Building materials, innovative materials (strawbale, adobe etc.)	
5	Construction technology: Old techniques as well as cutting edge technologies	
6	Thermal Comfort: Introduction to Psychrometric Chart.	Use of Climate Consultant Software
7	Ventilation Strategies- Natural as well as Mechanical	
8	Daylighting	Use AGi32 software for basic daylighting simulation.
9	Case Studies	Group project: To study an existing building and identify its energy efficient design strategies, along with energy efficiency measures recommendations.

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*.

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Module 2: Thermodynamics and HVAC Systems

Description:

The course on thermodynamics would enable the student to perform simple heat gain and heat loss calculations, understand different HVAC systems and their performance under different climatic conditions.

Certification(s): *see Unit Overview*

Prerequisite: Building Science Module

Required Materials: *Residential Energy: Cost Savings and Comfort,* by John Krigger and Chris Dorsi

Credit Hours: 2

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Define terms such as temperature, pressure, energy and power.
2. Perform simple heat transfer calculations.
3. Calculate air pressure, flow and infiltration.
4. Differentiate between power and energy as well as carry out simple calculations to determine the same.
5. Discuss various electric systems such as meters, equipments, lighting etc. and calculations involving the same.
6. Calculate EER and COP for heating and cooling systems
7. Discuss various heating and cooling systems, constant volume as well as variable air volume.
8. Discuss applicability of different system types, i.e, central packaged system versus a number of split systems, heat pumps and their advantages.
9. Perform simple calculations for various systems including unconventional systems such as ground source heat pumps etc.
10. Calculate air flow and fan power.
11. Define pressure drops and calculate the same.

Module 2: Thermodynamics and HVAC Systems		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Temperature and Heat	
2	Heat Loss and Gain	
3	Air Pressure and Flow	
4	Electric Power and Energy	
5	Electric Systems	
6	Define SEER, EER, COP for HVAC systems.	
7	HVAC Systems: Constant Volume and Variable Volume Systems	
8	Packaged and Split Systems	
9	Innovative HVAC systems: Ground Source Heat Pumps, Evaporative Cooling	
10	Calculating Fan Power and CFM	
11	Calculating Duct pressure drop	

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Module 3: Codes and Certificates

Description:

An overview of various building codes and certifications such as ASHRAE 90.1, IGCC and IECC would be provided. Building certification process (NAHB and LEED) would be briefly explained, for a general understanding. This course has three prime areas of focus:

1. Building codes
i. Building Certification
ii. Federal and State Policy towards weatherization and energy efficiency.

Certification(s): *see Unit Overview*

Prerequisite: None

Required Materials: ASHRAE Standard 90.1 2007, IECC 2009; and ASHRAE Standard 55

Credit Hours: 2

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss various buildings codes,
2. Discuss the various building certifications and applicability of the same.
3. Define the various compliance paths for building certifications.
4. Explain code compliance requirements for building certification.
5. Discuss federal and state incentives and utility rebate programs for energy efficiency.

Module 3: Codes and Certificates

Expected Outcome	Topic	Suggested Activities or Resources
1	Building Codes and Standards	ASHRAE 90.1 and IECC
2	Building Certification	LEED, NAHB and ENERGY STAR
3	Prescriptive and performance compliance paths	
4	Code Compliance for certification	
5	Federal and State incentives and Utility Rebate programs	

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Module 4: Internal Loads, Base Loads and Water Heating

Description:

The course would define the various internal loads and calculation procedures for the same. This is essential for any audit process. The student should be able to access the performance of equipments and should be aware of all technologies available in the market.

Certification(s): *see Unit Overview*

Prerequisite: Modules 1, 2, 3, 5

Required Materials: None

Credit Hours: 2

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss various water heating systems and identify the most efficient and appropriate ones.
2. Identify different lighting systems and calculate lighting power density (LPD) for homes.
3. Calculate equipment loads through load calculation of individual appliances as well as use of Kill-a-Watt meters.
4. Calculate both sensitive and latent occupant loads based on number of occupants present.
5. Calculate base loads due to receptacles etc.
6. Identify low efficiency appliances and corresponding rebates for their replacement.
7. Explain significance of EnergyStar rated appliances.

Module 4: Internal Loads, Base Loads and Water Heating		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Water Heating Basics	
2	Residential Lighting	
3	Residential Equipment and Appliances	
4	Occupant Loads	
5	Base Loads	
6	Incentives and Rebates for Appliance Replacement	
7	ENERGY STAR rated appliances	

Lab (1 credit hour): Use of Kill-a-Watt meters for base load calculations as well as to determine efficiency of appliances.

Workshops: Workshops organized by industry leaders for demonstration on the cutting edge technologies in lighting systems, water heating systems etc.

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*.

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Module 5: Building Energy Simulation

Description:

The energy audit process requires the auditor to evaluate home performance through energy analysis software such as REMrate and REMdesign, which would be taught in this course. Effectively simulating the building, calibrating it against utility bills and performing simulations to define the most appropriate energy conservation measures would be taught.

Certification(s): *see Unit Overview*
Prerequisite: None
Required Materials: None
Credit Hours: 3

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Adeptly use softwares for basic simulations.
2. Accurately model the building envelope and construction assemblies.
3. Accurately simulate envelope loads, internal loads (lighting, equipment and occupants) and infiltration to define building loads.
4. Simulate basic HVAC systems with accurate SEER and COP values
5. Determine energy efficiency measures.
6. Calculate costs and pay back periods for various energy efficiency measures.

Module 5: Building Energy Simulation		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	REScheck for code compliance analysis and REMrate and REMdesign for Energy Analysis	
2	Simulation of building envelope	
3	Simulation of Internal loads	
4	Simulation of HVAC systems	
5	Energy conservation measures	
6	Simple payback	

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

Additional Resources:

- ✓ RESCheck demonstration to show code compliance.
- ✓ REMrate for energy analysis, determine energy efficiency measures as well as HERs Index score.

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Module 6: Building Diagnostics

Description:

Basic pressure diagnostics, use of blower door for defining air leaks etc would be demonstrated in this course.

Certification(s): *see Unit Overview*

Prerequisite: Modules 1, 2, 3, 5, 7

Required Materials:

- *Residential Energy: Cost savings and Comfort.* Authors : John Krigger, Chris Dorsi
- *Saturn Energy Auditor Field Guide.* Authors: John Krigger and Chris Dorsi

Credit Hours: 3

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss the fundamentals of building science.
2. Be well aware of different active and passive system types.
3. Identify appropriate energy efficient design strategies as a response to different climatic conditions.
4. Enlist various construction materials (innovative materials such as straw bale, SIP) and their application.
5. Discuss effectiveness of traditional construction technologies versus new construction technologies.
6. Effective use the psychrometric chart for thermal comfort calculations.
7. Discuss various ventilation strategies.
8. Perform basic daylighting calculations and simulations.
9. Identify energy efficient design strategies in buildings and critique the same.

Module 6: Building Diagnostics		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Define leakage rate, causes and solutions.	
2	Define infiltration rate, its difference from leakage rate and calculation procedure from the same.	
3	Measure air leakage due to ducts etc.	
4	Calculate duct pressure.	
5	Perform diagnostics such as blower door, smoke stick test to determine sites of air leakage.	
6	Perform air sealing to minimize air leakage	
7	Perform weather-stripping to minimize infiltration.	
8	Discuss various combustion appliances such as furnaces, water heaters, ovens etc.	
9	Perform diagnostic tests to determine combustion efficiency and presence of pollutants (carbon monoxide etc.)	

Lab (2 credit hours): Use of equipment (blower door test, smoke stick, duct blaster test) for building assessment and air leakage diagnostic.

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

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Module 7: Ventilation and Indoor Air Quality

Description:

An introduction to ventilation standards, indoor air quality requirements, materials containing volatile organic compounds etc.

Certification(s): *see Unit Overview*

Prerequisite: None

Required Materials: None

Credit Hours: 3

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Define indoor air quality and its importance.
2. Identify various occupant health symptoms symbolic of poor IAQ, such as acute effects, chronic effects, discomfort, and performance effects.
3. Identify the various pollutants present inside homes.
4. Define source of indoor air pollutants (indoor and outdoor sources)
5. Define strategies to manage sources of pollutants to reduce the cause of the same.
6. Discuss various ventilation strategies and define the most appropriate strategy in accordance to pollutant type and source.
7. Identify presence of mold in homes.
8. Define cause of mold presence.
9. Define strategies to reduce mold growth such as thermostat set points, thermal bridges, windows etc.
10. Identify material with high VOC content.
11. Discuss applicability of ASHRAE 62.1 for ventilation requirements.

Module 7: Ventilation and Indoor Air Quality Outline		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Overview of IAQ	
2	Occupant Symptoms associated with poor IAQ	
3	Building factors affecting IAQ	
4	Types of Pollutants	
4	Contaminant Sources	
5	Managing major sources of pollutants in buildings.	
7	Mold	
6	Ventilation (Exhaust ventilation, dilution ventilation, ventilation measurements)	
7, 8, 9	Identifying and correcting common mold and moisture problems.	
8	Causes of Mold (Relative humidity, condensation and vapor pressure)	
10	VOC containing products.	

Activities: Workshop by industry partners on various green materials and certification for VOC emissions.

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

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Module 8: Energy Efficient Design - Construction and Retrofit

Certification(s): *See Unit Overview*
Prerequisite: Modules 1, 2
Required Materials:

- *Residential Energy: Cost Savings and Comfort by* John Krigger, Chris Dorsi and *Saturn Energy Auditor Field Guide* by John Krigger and Chris Dorsi

Credit Hours: 3

Description:

This course aims at proving training appropriate for building envelope assessment including wall assembly, insulation levels, window glass type, external shading, air barrier and window caulking.

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Identify various building envelope elements to be assessed for optimal performance
2. Identify need for air and vapor barrier repair.
3. Identify various types of fibrous insulation, applications and installation technique.
4. Indentify various kinds of foam insulation, their applicability and installation technique.
5. Define procedure for preparation of walls, ceilings and attics for insulation.
6. Explain procedure to be followed for floor and foundation insulation.
7. Define various door and window constructions; frame types and efficiency factors of each.
8. Identify various glass types (single pane, double pane, low e etc.) and perform basic calculations for center of glass U value, shading coefficient, SHGC and visible transmittance.
9. Define requirement for external shading in accordance to orientation, internal space type and external landscape as well as identify most appropriate kind of shading device (i.e. overhang versus louvers)
10. Perform window caulking.

Module 8: Energy Efficient Design: Construction and Retrofit		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	**Building Envelope Assessment** • Building Envelope • Air Barrier Repair • Fibrous Insulation • Foam Insulation • Wall, attics and ceiling insulation • Floor and Foundation Insulation • Doors and Windows • Glass Types • External Shading • Window Caulking	

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

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Module 9: Weatherization Demonstration

Description:

The weatherization demonstration aims to provide an overview of an audit process, including all aspects of building envelope assessment, diagnostics and IAQ analysis. Creating an audit report would also be demonstrated.

Certification(s): *see Unit Overview*

Prerequisite: None

Required Materials: None

Credit Hours: 2

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Perform basic building envelop assessment, window caulking, envelope insulation.
2. Perform basic energy audit diagnostic tests.
3. Analyze existing HVAC systems to determine their efficiency etc.
4. Perform basic energy simulations to determine energy use and energy conservation measures.
5. Create a preliminary energy audit report.

Module 9: Weatherization Demonstration		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Demonstration of building envelope assessment and retrofit	
2	Air leakage diagnostics	
3	HVAC systems analysis and repair/replacement	
4, 5	Energy Simulation and Energy Audit Report	

Notes: This would include small demonstrations by industry partners in the field of insulation, HVAC systems etc.

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

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Module 10: Inspection Protocol

Description:

Weatherization work involves communication with client as well as tedious inspection works in the attic. Raters should be proficient in both sides of work and have appropriate demeanor to imbibe confidence in client as well as employer. Hence this class would enlist the adequate inspection protocol to perform well not only at home audits but also in at job interview and all client communications, to sharpen interpersonal and communication skills.

Certification(s): *See Unit Overview*

Prerequisite: None

Required Materials: None

Credit Hours: 1

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Effective communicate, not just with a prospective employer, but also clients.
2. Conform to an adequate inspection protocol to perform well not only at home audits but also in at job interview and all client communications.

Module 10: Inspection Protocol		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Protocol with respect to interpersonal communication	
2	Communication – With clients as well as employers.	

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

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Module 11: Applied Projects

Description:

This class would provide an internship opportunity for students, to work with the industry partners to gain experience in energy auditing. The hands on training will give students an opportunity to apply the skills they learned in the energy auditing and weatherization course.

Certification(s): *See Unit Overview*

Prerequisite: None

Required Materials: None

Credit Hours: 6

They would install a blower door and measure building tightness, use a thermal imaging camera to identify insulation gaps and air leaks and test furnaces and ducts in the home.

The Applied project course is different from the Weatherization Demonstration course, as here, the student in directly involved in the process, whereas in the previous course, the student would be 'shadowing' a home energy auditor to see the complete procedure.

Performance Objectives:

Upon the completion of this course, students would be able to-

1. Proficiently perform a home energy audit.
2. Efficiently use equipments to perform diagnostics tests such as blower door.
3. Use thermal imaging camera to identify 'hot spots'
4. Effective assess building envelope.
5. Calculate air leakage and infiltration.
6. Measure equipment and lighting loads.
7. Perform energy simulation and create energy audit report.

Module11: Applied Projects Outline		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Energy Audit: Requirements	
2	Building Diagnostics	
3	Equipment Use for Envelope assessment	
4	Visual Building Envelope Assessment	
5	Air leakage and Infiltration	
6	Equipment and Lighting Loads	
7	Building Energy Simulation and Validation	

This course aligns with National Recognized Certifications in Green Building Design. For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org* or the Building Performance Institute, Inc. website at *www.bpi.org*

Credits:

- ✓ Material developed by Greenstreet
- ✓ Modified and updated by Samuel Breedlove, Heidi Vasiloff P.C.

This workforce solution was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership. This solution is copyrighted by the institution that created it. Internal use by an organization and/or personal use by an individual for non-commercial purposes is permissible. All other uses require prior authorization of the copyright owner.