BUILDING ENERGY TECHNOLOGIES CERTIFICATE PROGRAM

DISCIPLINE - 0027 (Env. Technology); OCCUPATIONAL CERTIFICATE CODE - 0159

TOTAL CREDIT HOURS: Twenty-One (21)
CURRICULUM LENGTH: Six (6) Classes
PREREQUISITES: Individual assessment of entering students by an academic advisor for the program, plus eligibility for college level reading, writing, and math. For Certificate eligible students, work experience and/or classwork providing background for an understanding of the course materials.

CATALOG DESCRIPTION: The Building Energy Technologies Curriculum at Wright College is a program of study examining concepts and theory, and providing experiential application of energy efficiency and renewable energy systems in the building construction and retrofit industry, leading to more energy efficient and lower cost operations of structures and facilities.

CURRICULUM CLIENTELE: Building owners and operators, construction tradesmen and contractors, engineering and environmental consultants, building inspectors (both government and private sector), real estate assessors, articulating students (to a four year degree).

CURRICULUM OBJECTIVE: The student will receive the background, skill, and knowledge to review, assess, implement, audit, optimize, and operate energy efficiency and alternative energy systems within a wide range of facility types, in both new construction and retrofit situations. With an emphasis on integration of these systems into basic building functions and construction management, the student obtains the expertise to coordinate and work effectively with architects, engineers, planners, and contractors on the installation and operation of the energy systems, and to promote those skills in the construction trades job marketplace.

LEARNING OUTCOMES: Successful completion of the six (6) course curriculum results in a Building Energy Technology Certificate, and provides the student with the background and practical skills to assist in the design, implementation, and functional operation of energy efficiency and building-specific renewable energy systems in industrial, commercial, and residential environments.

Individual courses could be utilized for CEU credits, pending approval of particular agencies or professional organizations. Building Operator Certification, a separate accrediting protocol, is attained through the successful completion of specific courses, EnvrTc 144 and 244, as noted.
COURSE TITLE / NO.: Building Energy Systems Fundamentals: Basic Design and Operation / Environmental Technology 104

CREDIT HOURS: Three (3)

CONTACT HOURS: Three (3) Lecture hours per week

COURSE LENGTH: One Semester – 16 Weeks

PREREQUISITES: or consent of the Department Chair.

CATALOG DESCRIPTION: Course covers the basics of building envelopes, HVAC, lighting, insulation, glazing, plumbing and electrical systems, construction materials, and the surrounding environment. Incorporates blueprint and design fundamentals. Focuses on construction engineering concepts. Introduces LEED® and Energy Star® programs, relevant environmental, health and safety principles, impacts, and regulatory implications. Provides a broad overview of energy use and efficiency in structures and why they matter. Writing assignments, as appropriate for the discipline, are part of the course.

COURSE CLIENTELE: This is a required course for students in the Building Energy Technologies Certificate Program, but may be taken by others who desire a working knowledge and experience with these concepts, and wish to enroll in subsequent BET curriculum courses.

COURSE GOALS: To expose the student to fundamentals of construction engineering and its integration into building energy systems, including comprehension of blueprints and engineering drawings, coordination on building design, compliance with audit programs and code requirements, and an overview of assessment measures.

LEARNING OUTCOMES: Through successful completion of the course materials and exam, the student will be able to:

1. read and comprehend engineering design documents;
2. demonstrate how the various systems draw energy and impact the control and functionality of buildings;
3. communicate with architects / engineers, construction contractors, tradesmen, regulators, auditors, and other stakeholders on the integration and operation of such systems;
4. describe the factors that lead to energy efficiency through the operation of such systems and the synergistic effects of the various systems with other structural features;
5. describe building and system energy efficiency programs and classifications, such as LEED® and Energy Star®, and their use and import in the construction and retrofit fields;
6. outline the practical skills that need to be developed to install and operate energy efficiency systems within various types of new and retrofitted structures;
7. define potential environmental, health & safety issues at the worksite related to energy systems, construction materials, and work practices;
8. explain the influence of building and zoning codes and other government programs on energy efficiency systems implementation; and,
9. matriculate to subsequent courses within the BET curriculum.

TOPICAL OUTLINE:

WEEK 1 - Introduction to the course;
  Instructional goals and student requirements;
  Introduction to various green building and sustainability concepts;

WEEK 2 - Blueprint and engineering drawing fundamentals (begin);

WEEK 3 - Blueprint and engineering drawing fundamentals (complete);

WEEK 4 - Green Building Assessment: LEED® Certification;
  Energy Star®, other certification programs;
  Local building / zoning requirements;

WEEK 5 - The Green Building Process: design/bid/build, the charrette, costs, negotiations, project management, documentation, and other planning activities (begin);

WEEK 6 - The Green Building Process (complete)
  An overview of Ecological Design concepts;
  Land use issues and the outdoor environment;

WEEK 7 - Building energy systems fundamentals;
  Alternative Energy Systems introduction

WEEK 8 - Passive efficiency systems: daylighting, ventilation, orientation, and landscaping;

WEEK 9 - Building Materials: identifying and purchasing green, delivery and storage, life-cycles, waste handling

WEEK 10 - The Building Envelope: wall systems, windows, and roofing;
WEEK 11 - Building Hydrologics: water supply and use, water conservation, water discharge and reclamation;

WEEK 12 – Building Mechanical Systems and Controls

WEEK 13 - Indoor Air Quality issues during construction and post-habitation;

WEEK 14 - Construction health and safety concerns;
WEEK 15 - The Building Commissioning process: individual systems and whole building commissioning;
Course review;

WEEK 16 – Final examination.

STUDENT PERFORMANCE EVALUATION:
25% - Graded homework;
15% - Class participation;
20% - Written quizzes covering major topics;
40% - Final written exam.

TEXTS / MATERIALS:
2. Workbook covering blueprint, engineering, drawing, and CAD fundamentals;
3. Other instructional materials, including but not limited to monographs, journal articles, and publications as selected by the instructor.

COURSEWORK DELIVERY METHODS:
Traditional classroom lecture, materials, quiz and examination methods.

COURSE EQUIVALENCY:
None, however, within the City Colleges of Chicago course catalog, see Architecture 115, 202, and 266; Engineering 131; and Machinist Program 0767 for individual topic matter correlation.
COURSE TITLE / NO.: Technical Aspects of Renewable & Alternative Energy Sources / Environmental Technology 114

CREDIT HOURS: Four (4)

CONTACT HOURS: Five (5): Three (3) Lecture hours per week; Two (2) Lab hours per week consisting of off-site experiential learning exercises at alternative energy equipment installation sites, including hands-on equipment and technologies auditing.

COURSE LENGTH: One Semester – 16 Weeks

PREREQUISITES: Placement in English 101, eligibility for college level mathematics, or consent of the Department Chairperson.

CATALOG DESCRIPTION: An introductory, work-skills course on principles, concepts, applications, and installation of renewable and alternative energy technologies as applied at the individual structure level. Distinguishes between technologies appropriate to large-scale, industrial / commercial settings versus those intended for smaller and residential structures. Covers the utilization of renewable energy sources (solar, wind, geothermal, etc.) as well as alternative technologies utilized for building operations (microturbines, fuel cells, combined heat and power). Designed to prepare tradesman for the installation of various technologies. Up to five (5) off-campus visits to alternative energy installations will be scheduled as part of this course. Writing assignments appropriate for the discipline are part of the course.

COURSE CLIENTELE: This is a required course for students in the Building Energy Technologies Certificate Program, or may taken by contractors, tradesmen, or others who purchase, install, or operate renewable or alternative energy technologies and desire to obtain employment skills in the Alternative Energy trades, or as an elective for the Environmental Technology Program Associate Degree students.

COURSE GOALS: To introduce the student to the necessary skills to prepare, install, and operate various types of alternative energy systems and equipment. Concepts of a wide array of alternative and renewable energy technologies and their applications will be presented in relation to structural and functional settings, as well as incorporation of such technologies into overall building energy systems.

LEARNING OUTCOMES: Through successful completion of the course materials, exam, and hands-on demonstrations of operational equipment, the student will have the background to:

1. determine which renewable and alternative energy technologies are appropriate and optimal in various environments and settings, and determine post-installation cost and energy savings from implementation;
2. outline the integration of the various technologies with other building energy systems;

3. help prepare and install, and assist in the start-up and troubleshooting of alternative and renewable energy systems and equipment on the job site;

4. assess the optimization and functionality of renewable and alternative technologies in operation;

5. work with architects, engineers and construction contractors as well as other tradesman on installation projects; and,

6. assess such systems for regulatory or code compliance, and achieving promotional program goals.

**TOPICAL OUTLINE:**

WEEK 1 - Introduction to the course;
   Instructional goals and student requirements;
   Alternative and Renewable Energy in the U.S.;
   Distributed generation versus individual site technologies:

WEEK 2 - Microturbines – theory and practice;
   Combined Heat & Power systems;

WEEK 3 - Field inspection / experiential learning of microturbine and CH&P systems (probable downtown locations);

WEEK 4 - Quiz on microturbine and CHP technologies;
   Biomass and fuel cell technologies – theory and practice;

WEEK 5 - Field inspection / experiential learning of biomass and fuel cell generation equipment (sites to be determined);

WEEK 6 - Quiz on biomass and fuel cell technologies;
   Geothermal heating and cooling – theory and practice;
   Hydropower theory and practice;

WEEK 7 - Solar thermal theory and practice;

WEEK 8 - Field inspection / experiential learning on geothermal and solar thermal systems and equipment (sites to be determined);

WEEK 9 - Quiz on geothermal and solar thermal technologies;
   Photovoltaic systems – theory and practice;

WEEK 10 - Field inspection / experiential learning on photovoltaic systems and equipment (sites to be determined);

WEEK 11 - Quiz on photovoltaic systems and equipment;
   Small wind turbine siting, theory, and practice;

WEEK 12 - Field inspection / experiential learning on small wind turbine siting, systems, and equipment (site to be determined);
WEEK 13 - Quiz on small wind turbine siting, systems, and equipment;

WEEK 14 - Local codes and permitting issues;
   State and Federal regulatory issues and opportunities;
   Implementation barriers;

WEEK 15 - Grid interconnections and economics;
   Course review;

WEEK 16 – Final examination.

STUDENT PERFORMANCE EVALUATION: 15% - Class participation;
   15% - Written quizzes covering individual alternative energy technologies;
   35% - Off-site field demonstrations of basic renewable / alternative energy installation and operation;
   35% - Final written exam

   2. Other instructional materials, including but not limited to monographs, journal articles, and publications as selected by the instructor.

COURSEWORK DELIVERY METHODS: Traditional classroom lecture, materials, quiz and examination methods;
   Off-site presentation: practical demonstrations of renewable energy systems, installations, and assessment techniques. This course is structured to be a hands-on, vocational trades-oriented tutorial. It will require coordination with local area manufacturers / distributors / installers in several technologies (wind, solar, etc.), who can utilize the course as a source of employment.

COURSE EQUIVALENCY: None.
COURSE TITLE / NO.: Building Operators Certification (BOC) Course: Building Systems Maintenance - Level 1 / Environmental Technology 144

CREDIT HOURS: Four (4)

CONTACT HOURS: Five (5) Three (3) Lecture hours per week; Two (2) Lab hours per week, consisting of small group project modules including design / planning, and energy auditing and accounting exercises.

COURSE LENGTH: One Semester – 16 Weeks

PREREQUISITES: Successful completion of Building Energy Systems Fundamentals: Basic Design and Operation Course (Envr Tc 104), or approval of the Department Chairperson.

CATALOG DESCRIPTION: Course is comprised of seven energy efficiency topics in building operations and maintenance. BOC is a professional development program in the energy and resource efficient operation of buildings to qualify operations and maintenance staff for certification. Writing assignments, as appropriate for the discipline, are part of the course.

COURSE CLIENTELE: This is a required course for students in the Building Energy Technologies Certificate Program, or those involved in building construction and rehabs, building operators and owners, inspectors, and others wishing BOC Certification status.

COURSE GOALS: To provide the student with the basic principles, background and skills of energy utilization, efficiency, and conservation with respect to building maintenance and operation. and the fundamentals of various building systems and equipment.

LEARNING OUTCOMES: Upon successful completion of the seven (7) class component topics and exams, the student will be able to:
1. explain the overview of building energy systems interaction and relationship to overall building performance;
2. perform energy accounting, evaluations of fuel options, and operation and maintenance strategies;
3. detail automatic energy control systems and equipment and preventive maintenance;
4. describe lighting fundamentals, space use and function;
5. explain the overview of health, safety, energy, and environmental impacts;
6. describe indoor air quality problems, diagnoses, and solutions;
7. describe the fundamentals of electricity and its application to the workplace; culminating in the
8. receipt of a Building Operators Certification, Level 1 qualification
TOPICAL OUTLINE:

WEEK 1 - Introduction to the course;
Instructional goals and student requirements;
Overview of preventive maintenance, energy efficiency principles, and fundamentals of building systems, equipment, and operations;
Review of heating, cooling, ventilation and control systems, water, lighting, and indoor air quality.

Project: Facility and Equipment Floor Plan
Written and/or oral exam on module.

WEEK 3 - Begin Energy Conservation Techniques module:
Understanding how energy is used in commercial buildings;
How to identify and prioritize conservation opportunities;
Basic principles of energy accounting,

WEEK 4 - Continue Energy Conservation Techniques module:
Evaluation of fuel options, operation and maintenance strategies to improve efficiency, and energy management planning techniques;
Project: Energy Use Profile for Facility
Written and/or oral exam on module.

WEEK 5 - Begin Facility Electrical Systems module:
Fundamentals of electricity and its application to the workplace.

WEEK 6 - Continue Facility Electrical Systems module: How electricity is distributed in a facility;
Common electrical distribution problems.
Project: Electrical Distribution Sketch for Facility
Written and/or oral exam on module.

WEEK 7 - Begin Efficient Lighting Fundamentals module: Lighting fundamentals and types of lighting for economical and energy efficient lighting systems;
Principles of efficient lighting including evaluation of lighting levels, quality and maintenance.

WEEK 8 - Continue Efficient Lighting Fundamentals module:
Lighting fixture and control technologies;
Common upgrades, retrofit and redesign options;
Management strategies as they apply to space use and function;
Project: Lighting Survey for Facility
Written and/or oral exam on module.

WEEK 9 - Begin HVAC Systems and Controls module: Operation and maintenance of equipment and components typically found in commercial buildings, including central heating, cooling, air and ventilating systems in buildings.
WEEK 10- Continue HVAC Systems and Controls module:
Provides introduction to automatic control systems and equipment, particularly for central air systems. Group problem solving and exercises with respect to preventive maintenance.

WEEK 11- Continue HVAC Systems and Controls module:
Group problem solving / exercises in preventive maintenance;

WEEK 12- Complete HVAC Systems and Controls module:
Project: Heating System Operational Review;
Written and/or oral exam on module.

WEEK 13- Begin Indoor Air Quality module: Basic causes of indoor air quality problems;
Developing a method of diagnosis and solution;

WEEK 14- Continue Indoor Air Quality module: Understanding the dynamic components of indoor air quality in relation to source control, occupant sensitivity and ventilation;
Communications with building occupants for reliable investigations without aggravating existing issues;
Written and/or oral exam on module.

WEEK 15- Begin Environmental Health and Safety Regulations Module: Health, safety, energy, and environmental codes that impact facility operation;
How to comply with the requirements of the most important health and safety codes.

WEEK 16- Continue Environmental Health and Safety Regulations module: How to use the energy and maintenance related codes to improve energy efficiency;
Written and/or oral exam on module;
Course review;
BOC Level 1 Certificate Award

STUDENT PERFORMANCE EVALUATION: 20% - Graded homework (Project related);
30% - Graded Module Projects (both individual and sub-groups)
15% - Class participation;
35% - Written and/or oral exams covering module topics


COURSEWORK DELIVERY METHODS: Traditional classroom lecture, materials, group projects, individual projects based upon independent student field surveys, individual module examinations;

COURSE EQUIVALENCY: This course is developed and licensed through an outside vendor (the Northwest Energy Efficiency Alliance), and successful completion results in a trade recognized educational Certificate.
COURSE TITLE / NO.: Residential Building Energy & Environmental Systems / Environmental Technology 204

CREDIT HOURS: Three (3)

CONTACT HOURS: Three (3) Lecture hours per week.

COURSE LENGTH: One Semester – 16 Weeks

PREREQUISITES: Successful completion of Building Energy Systems Fundamentals: Basic Design and Operation Course (Envr Tc 104), or approval of the Department Chairperson.

CATALOG DESCRIPTION: Course details energy systems and energy efficiency technologies utilized in single- and multi-family residential building types. Covers systems design and installation in both new construction and retrofit projects. Introduces field auditing techniques, environmental impacts (indoor air quality, asbestos, lead, voc's, radon, waste disposal issues, etc.), worker health & safety considerations, Energy Star® certification, building commissioning procedures, and local regulatory requirements. An off-site visit to a residential “green” building / construction site will be scheduled as part of this course. Writing assignments, as appropriate for the discipline, are part of the course.

COURSE CLIENTELE: A required course for students working in the Building Energy Technologies Certificate Program or those involved in residential building construction and rehabs in their work field.

COURSE GOALS: To provide the student with the background and basics of skills necessary to assist in the planning and design, installation, retro-fitting, assessment, and auditing of energy efficiency technologies and environmental indicators as applied to residential construction and rehab projects.

LEARNING OUTCOMES: Through successful completion of the course materials, exam, and demonstration of field auditing technique, the student will be able to:

1. detail advantages and problems in various energy efficiency systems applications within new construction and existing building rehabs and retrofits;
2. determine the appropriate, cost-effective, and optimal systems applications in single-family and multi-family residential structures;
3. work with architects, contractors, builders, on incorporating systems into design to achieve energy efficiency goals;
4. utilize simple engineering concepts (such as R factors, lighting measurements, diagnostics, air leakage testing, etc.) to assess energy efficiency;
5. transform these concepts into real-world experience by field auditing various structures for energy efficiency and potential improvements;
6. demonstrate an understanding of site design, framing, structural air sealing, comfort issues, HVAC, electrical and plumbing implications, and other factors leading to energy efficiency improvements;

7. evaluate construction plans, use Builder Option Plans, and utilize audit techniques to calculate Home Energy Ratings Systems score and earn Energy Star® or other certifications;

8. demonstrate an understanding of the building commissioning process and how the implementation of energy efficiency measures plays a role;

9. describe the immediate and long-term environmental impacts of construction techniques and building materials; and,

10. explain the interaction between local code requirements, the construction / rehab / retrofit process, and energy efficiency implementation

**TOPICAL OUTLINE:**

WEEK 1 - Introduction to the course;
   Instructional goals and student requirements;
   The ‘Whole Building’ design process;

WEEK 2 - Land selection and development;
   The Site Planning process;
   Urban concerns: Case Study: Bigelow Homes –Chicago, IL;

WEEK 3 - Construction Waste Management;
   Building Materials - selecting, purchasing, storing (begin);

WEEK 4 - Building Materials (complete): Case Study – Value Engineering;
   An overview of Renewable Energy strategies in residential construction;

WEEK 5 The Building Envelope – foundations, walls, floors, roofs, insulation, and windows – air vapor and moisture intrusion (begin);

WEEK 6 - The Building Envelope – foundations, walls, floors, roofs, insulation, and windows - air vapor and moisture intrusion (complete);

WEEK 7 - Heating and air conditioning systems and equipment;

WEEK 8 - Efficient Water Use – indoor water use systems and equipment (begin); Water heating;

WEEK 9 - Efficient Water Use (complete) – outdoor water use systems and equipment;
   Residential Electrical Systems (begin);

WEEK 10 - Residential Electrical Systems (complete) – lighting systems and equipment and appliances;

WEEK 11 - Indoor Environmental Issues - indoor air quality, radon, moisture control, ventilation, off-gassing, acoustics, safety;
WEEK 12 - Long-term building operations and maintenance concerns;

WEEK 13 - Building certification and commissioning – LEED®, Energy Star®, and other programs;
   Regulatory issues – local building codes and permitting

WEEK 14 - Off-site experiential learning visit to a “green” residential construction – class tour and auditing demonstration to an in-process or recently completed residential green building, as arranged by the instructor (may occur in a different class week, depending upon scheduling);

WEEK 15 - Review, discussion of site visit; Course review;

WEEK 16 - Final examination.

STUDENT PERFORMANCE EVALUATION:

20% - Graded homework;
15% - Class participation;
15% - Written quizzes covering major topics;
15% - Off-site field demonstration of energy efficiency auditing techniques;
35% - Final written exam.

TEXTS / MATERIALS:


3. Other instructional materials, including but not limited to monographs, journal articles, and publications as selected by the instructor.

4. Case Studies, as selected by the instructor.

COURSEWORK DELIVERY METHODS:

Traditional classroom lecture, materials, quiz and examination methods;
Case Studies from text and other sources;
Presentation at a residential construction or retrofit site, for a practical demonstration of energy efficiency systems installations and auditing techniques.

COURSE EQUIVALENCY:

None, however, within the City Colleges of Chicago course catalog, see Architecture 202, 204, and 266; and Environmental Technology 141 for individual topic matter correlation.
Commercial, Industrial, and High-Rise Building Energy & Environmental Systems / Environmental Technology 2 1 4

Three (3)

Three (3) Lecture hours per week.

One Semester – 16 Weeks

Successful completion of Building Energy Systems Fundamentals: Basic Design and Operation Course (Envr Tc 104), or approval of the Department Chairperson.

Course covers the types of energy systems and energy efficiency technologies in use in commercial, industrial, and high-rise buildings. Includes design, installation, testing, assessment, and operation of technologies in these structures, and details the integration of system control components. Also encompasses a synopsis of environmental, health & safety for construction and post-construction activities, Energy Star®, LEED® certification, other pertinent programs and regulatory aspects. An off-site visit to an institutional “green” building/construction site will be scheduled as part of this course. Writing assignments, as appropriate for the discipline, are part of the course.

This is a required course for students in the Building Energy Technologies Certificate Program, or those involved in commercial/industrial building construction and retrofits as part of their job duties.

To provide the student with background and basic skills to assist in the planning and design, installation, operation, testing, and control of energy efficiency technologies and environmental indicators as applied to large scale construction and retrofit projects.

Upon successful completion of the course material and exam, and demonstration of system control adequacy, the student will be able to:

1. determine the applicable and optimal systems applications in various types of commercial, industrial, and high-rise structures;
2. work with architects, contractors, engineers, utilities on incorporating systems into design to achieve energy efficiency goals;
3. utilize simple applied engineering concepts (lighting, air flow calculations, etc.) and the basics of computer modeling to assess energy efficiency for both the structural envelope and for indicated work spaces by function;
4. demonstrate an understanding of site design and construction, structural integrity, workplace comfort issues, HVAC, lighting, electrical, and plumbing systems, utilities integration, and other factors leading to energy efficiency improvements;
5. evaluate workplace functionality and processes and their integration (energy systems-wise) into the facilities’ overall energy efficiency ratings;
6. demonstrate an understanding of automatic and manual operation of the systems’ controls to produce optimized energy efficiency for the structure;

7. determine the factors leading to LEED®, Energy Star® and other voluntary program certifications and citations;

8. describe the immediate and long-term environmental, health & safety impacts of construction techniques and building materials; and,

9. explain the interaction between regulatory requirements, the construction/retrofit process, and energy efficiency implementation.

**TOPICAL OUTLINE:**

WEEK 1 - Introduction to the course;
   Instructional goals and student requirements;
   Case Study: The sustainable “institutional” building - unique challenges to building green (begin);

WEEK 2 - Case Study: The sustainable “institutional” building – unique challenges to building green (complete);
   Siting issues and the outdoor environment (begin);

WEEK 3 - Siting issues and the outdoor environment (complete);
   Construction waste management;

WEEK 4 - Green building materials: selecting, finding, purchasing, storing, utilizing;
   Health & Safety at the construction worksite (begin)

WEEK 5 - Health & Safety at the construction worksite (complete);
   Overview of renewable energy systems for institutional constructions;

WEEK 6 - The institutional building envelope – foundations, walls, floors, roofs, insulation, and windows (begin);

WEEK 7 - The institutional building envelope - foundations, walls, floors, roofs, insulation, and windows (complete);
   Efficient water management (begin)

WEEK 8 - Efficient water management (complete);
   Building electrical systems (begin);

WEEK 9 - Building electrical systems (complete);

WEEK 10 - HVAC systems and Indoor Air Quality (begin);

WEEK 11 - HVAC systems and Indoor Air Quality (complete);
   Building, electrical, fire safety codes and other regulatory issues (begin);

WEEK 12 - Local regulatory codes (complete);
   Long-term building operations and maintenance concerns;
WEEK 13 - Individual systems commissioning; Building commissioning; LEED® certification and other programs;

WEEK 14 - Off-site experiential learning visit to a "green" construction – class tour and auditing demonstration to an in-process or recently completed commercial, industrial, or high-rise green building, as arranged by the instructor (may occur in a different class week, depending on scheduling arrangements);

WEEK 15 - Review, discussion of site visit; Course review;

WEEK 16 - Final examination.

STUDENT PERFORMANCE EVALUATION: 20% - Graded homework; 15% - Class participation; 15% - Written quizzes covering major topics; 15% - Off-site field demonstration of energy efficiency auditing techniques; 35% - Final written exam


COURSEWORK DELIVERY METHODS: Traditional classroom lecture, materials, quiz and examination methods; Case Studies from text and other sources; Off-site presentation at an institutional site, for a practical demonstration of energy efficiency control systems operation, installation and auditing.

COURSE EQUIVALENCY: None, however, within the City Colleges of Chicago course catalog, see Architecture 202, 204, and 266; Environmental Technology 141; Electronic Industrial Maintenance 0502 and 0507 for individual topic matter correlation.


COURSE TITLE / NO.: Building Operators Certification (BOC) Course: Equipment Troubleshooting and Maintenance - Level II / Environmental Technology 244

CREDIT HOURS: Four (4)

CONTACT HOURS: Five (5): Three (3) Lecture hours per week; Two (2) Lab hours per week, consisting of small group project modules including design / planning, and energy auditing and accounting exercises.

COURSE LENGTH: One Semester – 16 Weeks

PREREQUISITES: Successful completion of BOC Level I course (Envr Tc 144) and Certification, or consent of the Department Chair.

CATALOG DESCRIPTION: A second tier course comprised of four (4) core classes in maintenance, operation, and diagnostics of electrical and HVAC systems, and two of four possible electives in system specialty topics. BOC is a professional development program in the energy and resource efficient operation of buildings to qualify operations and maintenance staff for certification. Writing assignments appropriate for the discipline are part of the course.

COURSE CLIENTELE: This is a required course for students in the Building Energy Technologies Certificate Program, or those involved in building construction and rehabs, building operation and ownership, inspectors, and others wishing Tier II Level BOC Certification.

COURSE GOALS: To provide the student with an advanced level program of maintaining, troubleshooting, diagnosing, and repairing energy efficiency systems, including planning and strategies for implementing programs, records, and auditing, as well as detailed emphasis on several specialty topics.

LEARNING OUTCOMES: Upon successful completion of four (4) core topics two (2) of four elective components, and exams, the student will be able to:

1. initiate and manage a preventive maintenance program that produces energy savings and equipment reliability;
2. locate and repair electrical problems, maintain operational procedures to prevent electrical problems, and evaluate power quality issues;
3. troubleshoot and improve the efficiencies of HVAC systems, conduct performance evaluation and efficiency optimization;
4. perform energy efficient operation, maintenance, and service of HVAC controls and related devices; plus,

Elective topics provide skills and knowledge in:
5. sampling, mitigation, prevention and troubleshooting of Indoor Air Quality problems resulting from equipment and building operations;
6. identification of motor uses and applications in facilities;
7. Identification of water savings measures in facilities;

8. knowledge of basic electrical control concepts, troubleshooting control circuits for energy using equipment and systems; culminating in the,

9. receipt of a Building Operators Certification, Level II qualification.

**TOPICAL OUTLINE:**

**WEEK 1** - Introduction to the course;
Instructional goals and student requirements;
Begin Preventative Maintenance and Operations module:
Using a preventive maintenance program to manage and implement preventive maintenance.
System review, from generated work orders to the tools that maintenance staff select;
Effective troubleshooting methods for problem identification, testing procedures, problem solving and operational analysis;
Development of troubleshooting service records.

**WEEK 2** - Continue Preventative Maintenance and Operations module:
Project: developed with instructor input;
Written and/or oral exam on module.

**WEEK 3** - Begin Advanced Electrical Diagnostics module:
Locating and repairing electrical opens, shorts, overloads, and high resistance.
The use of digital electric meters;
Maintenance and operational procedures to prevent electrical problems and evaluate power quality issues for a facility.

**WEEK 4** - Continue Advanced Electrical Diagnostics module:
Project: developed with instructor input;
Written and/or oral exam on module.

**WEEK 5** - Begin HVAC Troubleshooting and Maintenance module: Basic Troubleshooting and improving efficiencies of primary heating, cooling and ventilation systems of commercial buildings;
System performance evaluation and efficiency optimization of central boiler systems.

**WEEK 6** - Continue HVAC Troubleshooting and Maintenance module:
System performance evaluation and efficiency optimization of chiller systems;
Evaluation and efficiency optimization of vapor-compression cycles of AC and heat pump systems.

**WEEK 7** - Continue HVAC Troubleshooting and Maintenance module:
System performance evaluation and efficiency optimization of distribution and ventilation systems;

**WEEK 8** - Complete HVAC Troubleshooting and Maintenance module:
Project: developed with instructor input;
Written and/or oral exam on module.
WEEK 9 - Begin HVAC Controls & Optimization module:
Energy efficient operation, maintenance, and service of HVAC controls and related devices for central air systems commonly found in commercial buildings.

WEEK 10 - Continue HVAC Controls & Optimization module:
Control principles, components, computerized controls;
Calibrating the controlled sub-systems;
Written and/or oral exam on module.

WEEK 11 - Specialty Topic 1 - Introduction to Building Commissioning:
Overview of commissioning types;
The elements of a successful project;
Working with a commissioning service provider;
The building operator role in commissioning projects.

WEEK 12 - Continue Introduction to Building Commissioning module:
When, where, and what type of commissioning may be appropriate for their building or project;
How building operators can reduce commissioning costs through active participation in the process;
Establishing a list of expected work products from a third party commissioning service provider; Accessing available resources;
Written and/or oral exam on module.

WEEKS 13 – 16 - Begin Elective Specialty Topics: to be offered over the remaining four week class schedule, and selected from the following topic categories:

- **Advanced Indoor Air Quality** - using EPA recommend procedures for preventing and troubleshooting IAQ problems for equipment and building operations. Two week session.
- **Motors in Facilities** - how motors work and their uses and applications in facilities, and how to make effective repair/replacement decisions when motors fail. Two week session.
- **Water Efficiency for Building Operators** - water savings measures in commercial and institutional facilities through detection and repair of leaks, operational changes, and low-cost equipment improvements. One week session.
- **Mastering Electrical Control Circuits** – enhanced, hands-on electric control concepts, ladder-logic, wiring schematic fundamentals, and blueprint to panel-board recognition, providing building operators the ability to troubleshoot control circuits for energy using equipment and systems. One week session.
- **Electric Motor Management** - practical exercises, interactive discussion, and demonstrations of motor database software to calculate power costs for motors, identify improvements in motor management practices, uses of a database for repair/replace decisions, and repair specifications. One week session.
Enhanced Automation and Demand Reduction – technologies to help building personnel manage energy use, reduce electrical demand, and maintain/improve a building’s environment, including screen buildings to assess enhanced automation (EA) potential, lighting and HVAC technologies and control strategies, energy management and information systems, as well as EA implementation strategies. Two week session.

STUDENT PERFORMANCE EVALUATION:

10% - Graded homework (Project related);
30% - Graded Module Projects (both individual and sub-groups)
15% - Class participation;
30% - Written and/or oral exams on mandatory module topics;
15% - Written and/or oral exams on specialty electives topics.

TEXTS / MATERIALS:

Six (6) “Student Handbooks - BOC 201-204 and BOC 210-216” 3rd or 4th Editions, developed and published by the Northwest Energy Efficiency Alliance, Portland, Oregon, 2003. Other texts, materials covering specialty topics at the discretion of instructor.

COURSEWORK DELIVERY METHODS:

Traditional classroom lecture, materials, group projects, individual projects based upon independent student field surveys, in class-room equipment demonstrations, individual module examinations.

COURSE EQUIVALENCY:

This course is developed and licensed through an outside vendor, and successful completion results in a trade recognized educational Certificate.