**TCEN-ENVIRONMENTAL/ENERGY TECH (TCEN)**

**TCEN 101. Energy for the Next Generation**
*3 Credits (2+2P)*
This course will survey a broad range of sources of energy, types of energy, energy storage, and the forms of energy. Students will be exposed to theory in the classroom, laboratory exercises, and field trips to provide them with a solid foundation for all subsequent energy related environmental courses. Crosslisted with: OETS 101.

**Prerequisite(s)/Corequisite(s):** OETS 118 or MATH 120. Restricted to: Community Colleges only.

**TCEN 105. Building Analyst I**
*3 Credits (2+2P)*
This course is designed to provide the foundational knowledge and expertise necessary for the energy auditor and home performance contractor. Crosslisted with: OETS 105. Restricted to: Community Colleges only.

**TCEN 106. Building Analyst II**
*3 Credits (2+2P)*
Designed to prepare the student for the BPI Building Analyst Certification. This course will walk the student through the hands-on process of conducting visual building inspections, diagnostic testing, identifying improvement opportunities, documenting a home's performance and preparing a scope of work. Crosslisted with: OETS106.

**Prerequisite(s)/Corequisite(s):** TCEN 105 or OETS 105. Restricted to: Community Colleges only.

**TCEN 110. Photovoltaic Application**
*4 Credits (3+2P)*
This course will provide an introduction to Photovoltaic (PV) installation. The course will provide instruction on site selection, prep, installation, and maintenance for photovoltaic applications. Students that complete the course and have the opportunity to take the entry level exam with the North American Board of Certified Energy Practitioners (NABCEP) en route to becoming Certified Installers. Crosslisted with: OETS110.

**Prerequisite(s)/Corequisite(s):** TCEN 101 or OETS 101. Restricted to: Community Colleges only.

**TCEN 111. Basic Electrical Principles I, DC Circuits**
*4 Credits (3+2P)*
Course begins with the basics of electricity and DC circuits. Includes categorization of material properties within conductors, semiconductors, and insulators. Gradual progression tackles more complex topics like DC circuit analysis of series and parallel circuits, including Kirchhoff's laws, Thevenin's & Norton's theorems, and superposition. Finally DC combination circuits, magnetism and electromagnetism, generators and motors are covered. Emphasis on safety throughout. May be repeated up to 4 credits.

**Prerequisite(s)/Corequisite(s):** OETS 104 or MATH 120. Restricted to Community Colleges campuses only.

**TCEN 112. PV Power Generation Design Fundamentals**
*3 Credits (2+2P)*
A study of photo voltaic design basics, photo voltaic (PV) Cells, modules, and system components; electrical circuits; grid-tied/grid-interactive PV system design and sizing for use on homes; solar electric products and applications; and understanding energy conversion from sunlight to electricity, and working with solar conversion equipment. Pre/ May be repeated up to 3 credits.

**Prerequisite(s)/Corequisite(s):** TCEN 111 and (OETS 104 or MATH 120). Restricted to Community Colleges campuses only.

**TCEN 113. OSHA 10 Hour Construction Hazard Identifications**
*1 Credit*
Intended for entry-level participants to provide instruction on a variety of construction safety and health standards. Topics include Introduction to OSHA, Electrical, Ladder, Excavation, Scaffold, and Forklift Hazards, Fall Protection, Materials Handling, Personnel Protective Equipment and Confined Space Entry Hazards. Meets OSHA 10-Hour Requirements.

**TCEN 115. Wind Power Generation Design Fundamentals**
*3 Credits (2+2P)*
Course covers wind turbine module descriptions and functions and wind system installation, operation, and troubleshooting. Additional topics include wind energy harvesting and the conversion process from the generator system to electricity. May be repeated up to 3 credits.

**Prerequisite(s)/Corequisite(s):** TCEN 111 and (OETS 104 or MATH 120). Restricted to Community Colleges campuses only.

**TCEN 121. Basic Electrical Principles II, AC Circuits**
*4 Credits (3+2P)*
Course begins with an overview of the primary components of AC circuits, such as resistors, inductors, rectifiers, transformers and capacitors, and then gradually introduces new, more complicated topics like applying AC principles in power generation and generators, motors, parallel and combination circuits, troubleshooting and evaluation of circuit conditions. May be repeated up to 4 credits.

**Prerequisite(s)/Corequisite(s):** TCEN 111 and (OETS 104 or MATH 120). Restricted to Community Colleges campuses only.

**TCEN 130. Introduction to Biomass/Biogas**
*3 Credits (2+2P)*
Introduction to utilization of renewable biological wastes including crops for production of fuels. Anaerobic digestor, gasification, pyrolysis, combustion and fermentation will be covered.

**Prerequisite(s)/Corequisite(s):** TCEN 101 or OETS 101. Restricted to: Community Colleges only.

**TCEN 140. Biofuel Science**
*3 Credits (2+2P)*
Fundamentals of basic organic chemistry and biochemistry applied to biofuel synthesis. Students will also be introduced to concept of conservation of matter and chemical reactions. Restricted to: Community Colleges only.
TCEN 156. Building Envelope
3 Credits (2+2P)
Designed to prepare the student for the BPI Building Envelope Certification. This course will provide the principles behind building envelope performance testing and the purpose of completing a comprehensive energy audit. Through lecture and subsequent field training, the student will learn how to use building diagnostics to develop a prescriptive plan for enhancing comfort, health & safety, building durability, and energy savings. The student will learn how to outline the follow-up process required after completion of the retrofit. Crosslisted with: OETS156. Restricted to: Community Colleges only. Prerequisite(s): TCEN 106 or OETS 106.

TCEN 180. Bio-diesel and Bio-ethanol Production
4 Credits (2+4P)
Overview of the production of biofuels. Students will be introduced to current biofuel production processes, trans-esterification, hydrogenation and fermentation reactions, distillation, and laboratory synthesis of biofuels and engine performance tests. Restricted to: Community Colleges only. Prerequisite(s): TCEN 140.

TCEN 205. NEC for Alternative Energy
4 Credits (2+4P)
This hands-on course will cover the National Electrical Code specifics concerning photovoltaic installation. Also code compliant wiring of basic electrical systems will be covered. Existing installations will be visited and studied. Restricted to: Community Colleges only. Prerequisite(s): TCEN 101 and ELT 105.

TCEN 210. Solar Thermal
4 Credits (2+4P)
The purpose of this course is for students to learn to install solar thermal collectors for several applications, including domestic hot water, pool heating, and space heating. Students will be able to identify types of systems and components, adapt a system design, conduct a site assessment, install solar collectors, install components, install control systems, perform a system checkout, and maintain and troubleshoot a solar thermal system. Restricted to: Community Colleges only. Prerequisite(s): TCEN 101 or OETS 101.

TCEN 215. Fluid Thermal Systems
4 Credits (2+4P)
Fluid properties and measurement, piping and tubing standards, pumps and operation. Restricted to: Community Colleges only. Prerequisite(s): PHYS 110G or PHYS 211G.

TCEN 220. Cooperative Experience
1-3 Credits (1-3)
Supervised cooperative work program. Student is employed in an approved occupation and supervised and rated by the employer and instructor. May be repeated up to 6 credits. Consent of Instructor required. Prerequisite(s)/Corequisite(s): MAT 235. Prerequisite(s): TCEN 180. Restricted to: TCEN majors. S/U Grading (S/U, Audit). Restricted to: Community Colleges only.

TCEN 221. Roofing Materials and Methods
3 Credits (2+2P)
Covers application techniques and estimation of asphalt and wood roofing products and accessories including gutters and flashing. Presents roof penetration, roof loading issues, and energy systems installation requirements for mounting photo voltaic or solar thermal systems. Prerequisite(s): TCEN 112.

TCEN 222. Photo Voltaic Grid Tie Installation
4 Credits (3+2P)
This is a more advanced course culminating in a PV system-to-grid connection. This course includes gathering site specific data, design, wire type and sizing specific to project, installation of all solar modules and balance of system (BOS) components, and grounding and bonding of system components, all in accordance with the latest NEC. Upon project design approval a system will be commissioned for the grid. Decommissioning will commence after measurements and troubleshooting as directed by the instructor. May be repeated up to 4 credits. Prerequisite(s)/Corequisite(s): TCEN 121 and TCEN 223. Prerequisite(s): TCEN 111 and TCEN 112. Restricted to Community Colleges campuses only.

TCEN 223. Photo Voltaic National Electrical Code Principles
2 Credits (2+1P)
Focuses on all sections of the National Electrical Code and local code requirements applicable to photo voltaic electrical installation. A partial list of areas covered is chapters one through four and section 690, "Solar Photovoltaic Systems" of the National Electrical Code. Pre/ Corequisite(s): TCEN 112.

TCEN 224. Field Experience
1-3 Credits (1-3)
Student will collaborate with instructor in proposing, defining, implementing, and analyzing outcomes of a project in the Environmental and Energy fields of study. May be repeated up to 6 credits. Consent of Instructor required. Restricted to: TCEN majors. Restricted to: Community Colleges only.

TCEN 240. Renewables and Sustainability
3 Credits
Various renewable energy technologies and sustainable design practices will be introduced. Restricted to: Community Colleges only. Prerequisite(s): TCEN 101 or OETS 101.

TCEN 241. Solar Thermal SHW Principles/Installation and Maintenance
3 Credits (2+2P)
Course presents the theory, installation, operation, and maintenance of solar hot water (SHW) systems. Topics include the types of systems to choose, the costs associated with SHW installation and operation, system sizing requirements, batteries and battery chemistry. May be repeated up to 3 credits. Restricted to Community Colleges campuses only. Prerequisite(s): OETS 104 or MATH 120.

TCEN 246. Building Weatherization & Auditor Fundamentals
3 Credits
Course provides information on how to locate air leaks and identify heat losses or gains through specific testing. Students will learn how to inspect and evaluate building envelopes, mechanical systems, and ventilation systems to determine the safety and energy consumption for each system. May be repeated up to 3 credits. Restricted to Community Colleges campuses only. Prerequisite(s): TCEN 113 and OETS 104. Corequisite(s): TCEN 221.
TCEN 250. Photo Voltaic System Integrator Fundamentals
3 Credits
Teaches the student project management fundamentals for working with homeowners, businesses, government, contractors, and manufacturers to design, build, and install complete alternative energy systems. Covers photovoltaic, small wind, and micro-hydro system designing, permitting, budgeting, and cost estimating requirements. Prerequisite(s): ET 125.
Corequisite(s): TCEN 222.

TCEN 251. Advanced Photo Voltaic On/Off Grid Installation
3 Credits (2+2P)
Photo Voltaic advanced topics to include panel racking and installation, battery storage, charge controllers, mechanical integration of arrays on buildings, and key elements involved in choosing a mounting system. May be repeated up to 3 credits. Prerequisite(s)/Corequisite(s): TCEN 222. Restricted to Community Colleges campuses only.

TCEN 252. NABCEP Entry-Level Exam Review
1 Credit
Course presents knowledge, key terms, and concepts of photovoltaic systems and solar hot water systems as related to the NABCEP Entry-level exam. This exam is for those wanting to enter the workforce in either solar thermal or solar PV. Scheduling and taking the exam is the responsibility of the student. May be repeated up to 1 credits. Consent of Instructor required. Prerequisite(s)/Corequisite(s): TCEN 253. Prerequisite(s): TCEN 222. Restricted to Community Colleges campuses only.

TCEN 253. Renewable Energy System Troubleshooting and Maintenance
3 Credits (2+2P)
Covers wind, solar and solar thermal system troubleshooting and maintenance topics to include equipment, electrical, and installation problem areas. May be repeated up to 3 credits. Prerequisite(s)/Corequisite(s): TCEN 251. Prerequisite(s): TCEN 222. Restricted to Community Colleges campuses only.

TCEN 254. Renewable Energy Internship
2 Credits
Student will receive industry-related renewable energy experiences at an approved industry location. Typical areas of hands-on practices will be installing solar PV, solar hot-water systems, or wind energy systems. May be repeated up to 6 credits. Consent of Instructor required. Restricted to Community Colleges campuses only. Prerequisite(s): TCEN 112 and 113 and 222.