

## **SYLLABUS**

<b>LAST REVIEW</b>	Fall 2022
<b>COURSE TITLE</b>	Alternative Energy Sources (Solar, Wind)
<b>COURSE NUMBER</b>	BEMT 0280
<b>DIVISION</b>	Career and Technical Education
<b>DEPARTMENT</b>	ELET
<b>CIP CODE</b>	46.0401
<b>CREDIT HOURS</b>	2
<b>CONTACT HOURS/WEEK</b>	Class: 1            Lab: 2
<b>PREREQUISITES</b>	None

### **COURSE DESCRIPTION**

Students will have the opportunity to install manual and magnetic starters and contactors. The photoelectric and proximity controls and controls for agricultural and commercial equipment will be studied.

### **PROGRAM LEARNING OUTCOMES**

Students will demonstrate an adherence to safety standards and proficiency in the installation or repair of residential electrical, plumbing, HVAC, exterior building materials, roofing, irrigation systems, landscape/hardscape, concrete placement and finish, masonry install and repair.

### **TEXTBOOKS**

<http://kckccbookstore.com/>

### **METHOD OF INSTRUCTION**

A variety of instructional methods may be used depending on content area. These include but are not limited to lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, panels, conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

### **COURSE OUTLINE**

- I. Photovoltaic
  - A. Introduction to Photovoltaic (PV) Systems
    - i. Historical Development of PV
    - ii. Overview of PV usage in the world
  - B. Solar energy potential for PV
    - i. Irradiance

- ii. Solar Radiation and spectrum of sun
  - iii. Geometric and atmospheric effects on sunlight
- C. Photo Voltaic Effect
  - i. Conversion of solar energy into electrical energy
  - ii. Behavior of Solar cells
- D. Solar cell's Basic structure and characteristics
  - i. Single-Crystalline
  - ii. Multi-Crystalline
  - iii. Thin Film silicon solar cells
  - iv. Emerging new technology
- E. Electrical Characteristics of the solar cell
  - i. Equivalent Circuit
  - ii. Modeling of solar cells including the effects of temperature
  - iii. Irradiation and series/shunt resistances on the open circuit voltage and short circuit current
- F. Solar Cell Arrays
  - i. PV Models
  - ii. PV Generators
  - iii. Shadow effects and bypass diodes
  - iv. Hot spot problem in PV module and safe operating area
  - v. Terrestrial PV Mode modeling
- G. Interfacing PV Models to loads
  - i. Direct connection of loads to PV modules
  - ii. Connection of PV modules to a battery and load together
- H. Energy Storage Alternatives for PV systems
  - i. Storage batteries
  - ii. Lead acid
  - iii. Nickel-Cadmium
  - iv. Nickel-Metal-Hydride
  - v. Lithium type batteries
  - vi. Small storage systems employing ultra-capacitors
  - vii. Charging and discharging properties of and modeling of batteries
- I. Power conditioning and max power point tracking (MPPT) algorithms
  - i. Based on buck and boost converter technology
- J. Maximum power point tracking (MPPT) algorithms
- K. Inverter control topography for stand-alone and grid connected operations
  - i. Analysis of inverter at fundamental frequency and at switching frequency
  - ii. Feasible operation region of inverter at different power factor values for grid-connected system
- L. Stand-alone PV systems
  - i. Consumer applications
  - ii. Residential systems
  - iii. PV water pumping

- iv. PV Powered lighting
- v. Rural electrification
- M. Grid Connected (Utility Interactive) PV systems
  - i. Active power filtering with real power injection
- N. Modeling and simulation of stand-alone and grid-connected PV systems.

## II. Wind Power Generation

- A. Introduction
- B. Historical Perspectives on Wind Turbines
  - i. Windmills and Wind Turbines
  - ii. Global Installations
  - iii. Case Study – Aermotor Windmill
- C. Wind Energy System Components
  - i. Blades, Hub, nacelle
  - ii. Gearbox, generator, breaks
  - iii. Tower, foundation, control system
- D. Turbine Design
  - i. Review of Fluid Concepts
  - ii. Aerodynamics and wind machines
  - iii. Blade Design
- E. Mechanics and Dynamics
  - i. Drivetrain Components
  - ii. General Principles Primer (stress, strain, vibrations)
  - iii. Rotor Dynamics
- F. Electrical Aspects of Wind Turbines
  - i. Electrical Fundamentals
  - ii. Electrical Machines
  - iii. Power Converters and Ancillary Equipment
- G. Fatigue and Wind Turbine Design
  - i. Primer on Fatigue
  - ii. Fatigue in Wind Systems
  - iii. Wind Turbine Design Process
- H. Wind Turbine Control
  - i. Control Primer
  - ii. Wind Turbine Model
  - iii. System Monitoring
- I. Wind Energy System Economics
  - i. Engineering Economic Basics
  - ii. Wind Turbine Cost Analysis
- J. Wind Farm Feasibility Study
  - i. Wind Turbine Siting
  - ii. Environmental and Wildlife impacts
  - iii. Noise Issues
- K. Conclusion

## **COURSE LEARNING OUTCOMES**

Upon successful completion of this course, the student will:

- A. Follow manufacturer's instructions and diagrams and install manual and magnetic starters and contactors.
- B. Follow manufacturer's instructions and diagrams and install photoelectric controls.
- C. Follow manufacturer's instructions and diagrams and install proximity controls.
- D. Install controls for commercial equipment.
- E. Define common abbreviations.
- F. Explain devices and symbols.
- G. Use control circuit schematic components.
- H. Explain magnetic control.
- I. Use lighting contractors.
- J. Overloads, magnetic starters - two wire circuits.
- K. Light-up pilot lights.
- L. Use multiple pushbuttons.
- M. Explain selector switches.
- N. Use reversing controls - three phases.
- O. Explain reversing controls - garage door - single phase.
- P. Use three phase motors-wye and delta configurations.
- Q. Use dual voltage - three phase motors.

## **ASSESSMENT OF COURSE LEARNING OUTCOMES AND COMPETENCIES**

Student progress is evaluated through both formative and summative assessment methods. Specific details may be found in the instructor's course information document.

## **COLLEGE POLICIES AND PROCEDURES**

*Student Handbook*

<https://www.kckcc.edu/files/docs/student-resources/student-handbook-and-code-of-conduct.pdf>

*College Catalog*

<https://www.kckcc.edu/academics/catalog/index.html>

*College Policies and Statements*

<https://www.kckcc.edu/about/policies-statements/index.html>

*Accessibility and Accommodations*

<https://www.kckcc.edu/academics/resources/student-accessibility-support-services/index.html>.