STATE UNIVERSITY OF NEW YORK COLLEGE OF TECHNOLOGY CANTON, NEW YORK



MASTER SYLLABUS

COURSE NUMBER – COURSE NAME ECMR - 175 Photovoltaic Installer

CIP Code: 46.0399 For assistance determining CIP Code, please refer to this webpage <u>https://nces.ed.gov/ipeds/cipcode/browse.aspx?y=55</u> or reach out to Sarah Todd at todds@canton.edu

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Updated by:

Canino School of Engineering Technology

Department: Mechanical & Energy Technology

Semester/Year: Fall 2022

- A. TITLE: Photovoltaic Installer
- B. COURSE NUMBER: ECMR 175
- C. CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)

Credit Hours: 3
Lecture Hours: 2 per week
Lab Hours: 2 per week
Other: per week

Course Length: 15 Weeks

- D. WRITING INTENSIVE COURSE: Yes \Box No \boxtimes
- E. GER CATEGORY: None: Yes: GER *If course satisfies more than one*: GER
- F. SEMESTER(S) OFFERED: Fall Spring Fall & Spring

G. COURSE DESCRIPTION:

This course is designed to instruct on the installation and maintenance of photovoltaic systems. The course includes installation of components and sub-systems based on the particular types of systems. As part of the course students will review permits requirements, alignment of arrays based on south orientation and building roof designs, mounting options, wind loading, aesthetic wiring that complies with NEC. Taught are the ways to verify the system is working, open circuit testing, short circuit testing, start-up and shutdown, and emergency response with proper labeling.

H. PRE-REQUISITES: None \boxtimes Yes \square If yes, list below:

CO-REQUISITES: None \boxtimes Yes \square If yes, list below:

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome	Program Student		ISLO & SUBSETS
<u>[SLO]</u>	<u>Learning</u>	<u>GER</u>	
	<u>Outcome</u>	[<i>If</i>	
	[PSLO]	Applicable]	

 Identify the components of a photovoltaic system Select the correct wire and conduit size 		ISLO 5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets Subsets
2. Select the concert whe and conduit size		5-Ind, Prof, Disc, Know Skills ISLO	
3. Determine the proper grounding connections per code	PSLO 3 NEC Code	ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
4. Describe how solar radiation produces electricity via panels		ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
5. Determine the power consumption of a building and size the correct number of panels		ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
6. Design the layout of the charge controller, inverter, and disconnects to comply with the code		ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
7. Correctly install panels for flat, pitched roofs, ground mount and wind load		ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
8. Calculate the cost of photovoltaic system installation		ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
		ISLO ISLO ISLO	Subsets Subsets Subsets Subsets
		ISLO ISLO ISLO	Subsets Subsets Subsets Subsets

KEY	Institutional Student Learning Outcomes [ISLO 1 – 5]
ISLO #	ISLO & Subsets
1	Communication Skills Oral [O], Written [W]
2	Critical Thinking Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]
3	Foundational Skills

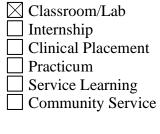
	Information Management [IM], Quantitative Lit,/Reasoning [QTR]
4	Social Responsibility Ethical Reasoning [ER], Global Learning [GL],
	Intercultural Knowledge [IK], Teamwork [T]
5	Industry, Professional, Discipline Specific Knowledge and Skills

*Include program objectives if applicable. Please consult with Program Coordinator

APPLIED LEARNING COMPONENT: J.

Yes 🖂 No

If YES, select one or more of the following categories:



- Civic Engagement Creative Works/Senior Project

Research

Entrepreneurship

(program, class, project)

K. <u>TEXTS</u>:

Dunlop, James P., Photovoltaic Systems, 3rd edition, American Technical Publishers, Inc., 2012

L. REFERENCES:

Holt, Mike, Understanding NEC Requirements for Solar Photovoltaic Systems, Mike Holt Enterprises, Inc., 2011

- M. EQUIPMENT: None \boxtimes Needed:
- N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

Exams Homework Lab Projects

P. DETAILED COURSE OUTLINE:

I. Solar Radiation

- a. Sun Earth Relationship
- b. Solar Radiation Data Sets
- II. Site Survey and Planning
- a. Site survey
- **b.** Preparing proposal
- c. Installation planning
- **III. System compopents**
- a. Panels
- **b.** Inverters
- c. Charger controllers
- d. Balance of Systems
- **IV. Arrays**
- a. Cells
- **b. Modules**
- c. Arrays
- V. Batteries
- a. Types
- **b.** Battery systems
- c. Maintenace
- VI. Charge Controller
- a. Features
- b. Types
- c. Setpoints
- VII. Inverters
- a. AC Power
- **b.** Power conditioning units
- c. Features and specificiation

VIII. System Sizing

- a. Methodologies
- **b.** Calculations
- **IX.** Mechanical Installation
- a. Array Mounting
- **b.** Roof penatrations
- c. Disconnect and service entrance mounting
- X. Electrical Integration
- a. NEC
- **b.** Utilities
- c. Conductors
- d. Grounding
- e. Interconnection
- f. Permitting and inspection
- XI. Commissioning, Maintenance, and Troubleshooting
- **XII. Economic Analysis**

Q. LABORATORY OUTLINE: None \Box Yes \boxtimes

- 1. Cell voltage and current
- 2. Module Shading IV Curves
- 3. Solar Pathfinder and predictive tools to plan energy
- 4. Energy audit of building
- 5. Batteries parallel and series connections
- 6. Charge controllers
- 7. Wiring Inverters
- 8. Sizing the array
- 9. Roof mounting hardware
- **10.** Box hanging and conduit installation
- **11. Mounting of panels**
- 12. Proper wire connections and grounding