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
https://nces.ed.gov/ipeds/cipcode/browse.aspx?y=55
or reach out to Sarah Todd at todds@canton.edu

Created by: Michael J. Newtown, P.E.

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 ☐ No ☒

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** ☒ **Yes** ☐ **If yes, list below:**

CO-REQUISITES: **None** ☒ **Yes** ☐ **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 [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***

1. Identify the components of a photovoltaic system			ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
2. Select the correct wire and conduit size			ISLO 5-Ind, Prof, Disc, Know Skills ISLO	Subsets Subsets Subsets Subsets
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

J. APPLIED LEARNING COMPONENT: Yes ☒ No ☐

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

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service

- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship

(program, class, project)

K. TEXTS:

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** ☒ **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** ☐ **Yes** ☒

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