MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
AREA 323 - PHOTOVOLTAIC SYSTEMS

Created by: Michael J. Newtown, P.E.
Updated by: Kibria Roman, Ph.D, P.E.

Canino School of Engineering Technology

Department: Mechanical & Energy Technology

Semester/Year: Fall/2018
A. **TITLE:** Photovoltaic Systems

B. **COURSE NUMBER:** AREA 323

C. **CREDIT HOURS:** (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)

   # Credit Hours: 3
   # Lecture Hours: 3 per week
   # Lab Hours: 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:**

   Photovoltaic Systems examines the direct conversion of solar energy to electricity. Topics include photovoltaic (PV) cell physics, types of PV cells, PV system components, and PV energy storage.

H. **PRE-REQUISITES:** None ☐ Yes ☒ If yes, list below:

   MECH 225, Introduction to Thermodynamics

   **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:

<table>
<thead>
<tr>
<th>Course Student Learning Outcome [SLO]</th>
<th>Program Student Learning Outcome [PSLO]</th>
<th>GER [If Applicable]</th>
<th>ISLO &amp; SUBSETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>calculate the size of battery bank, and array based on system requirement</td>
<td>SO # 6 An ability to identify, analyze and solve technical problems.</td>
<td>2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO</td>
<td>PS Subsets Subsets Subsets</td>
</tr>
<tr>
<td>calculate expected hourly and annual array power output.</td>
<td>SO # 6 An ability to identify, analyze and solve technical problems.</td>
<td>2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO</td>
<td>PS Subsets Subsets Subsets</td>
</tr>
<tr>
<td>evaluate the current state of array performance of various PV cell technologies.</td>
<td>SO # 8 A recognition of the need for, and an ability to engage in lifelong learning.</td>
<td>2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO</td>
<td>CA Subsets Subsets Subsets</td>
</tr>
<tr>
<td>design a stand-alone / utility interactive PV system.</td>
<td>SO # 7 An ability to communicate effectively through written, oral, and graphic methods related to renewable energy systems.</td>
<td>1-Comm Skills 2-Crit Think 5-Ind, Prof, Disc, Know Skills</td>
<td>W CA Subsets Subsets</td>
</tr>
<tr>
<td>calculate life cycle cost of PV system and compare it with other competing technologies.</td>
<td>SO #1 An appropriate mastery of the knowledge, techniques, and skills, and modern tools of their disciplines utilizing renewable energy systems and design parameters</td>
<td>1-Comm Skills 2-Crit Think 5-Ind, Prof, Disc, Know Skills</td>
<td>W CA Subsets Subsets</td>
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**KEY**

<table>
<thead>
<tr>
<th>ISLO #</th>
<th>Institutional Student Learning Outcomes [ISLO 1 – 5]</th>
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<tbody>
<tr>
<td>1</td>
<td>Communication Skills Oral [O], Written [W]</td>
</tr>
<tr>
<td>2</td>
<td>Critical Thinking Critical Analysis [CA], Inquiry &amp; Analysis [IA], Problem Solving [PS]</td>
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<tr>
<td>3</td>
<td>Foundational Skills Information Management [IM], Quantitative Lit./Reasoning [QTR]</td>
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<tr>
<td>4</td>
<td>Social Responsibility Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]</td>
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<tr>
<td>5</td>
<td>Industry, Professional, Discipline Specific Knowledge and Skills</td>
</tr>
</tbody>
</table>

*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:**

Photovoltaic Systems Engineering by R. A. Messenger and J. Ventre (CRC Press) 2004

L. **REFERENCES:**


M. **EQUIPMENT:** None ☒ Needed:

N. **GRADING METHOD:** A-F

O. **SUGGESTED MEASUREMENT CRITERIA/METHODS:**

Grading may include homework, quizzes, exams, and a design project.

P. **DETAILED COURSE OUTLINE:**

1. The Sun
   i. Solar radiation spectrum
   ii. Atmospheric effects on sunlight
   iii. Insolation and orientation

2. PV System Components
   i. PV cells, modules, and arrays
   ii. Energy storage
   iii. PV system loads
   iv. PV system availability
   v. Associated electronics (charge controllers, inverters, power trackers)
   vi. Wiring and code compliance

3. PV System Examples
   i. PV powered water pumping
   ii. PV powered lighting
   iii. Hybrid system
   iv. Utility interactive system
   v. Cathodic protection system
vi. Portable PV applications

4. Stand-Alone PV Systems
   i. Critical need system
   ii. Remote PV application
   iii. Hybrid system
   iv. Battery issues

5. Utility Interactive PV Systems
   i. System sizing and economics
   ii. Net metering
   iii. Small (<10 kW) utility interactive PV systems
   iv. Medium utility interactive PV systems
   v. Large utility interactive PV

6. PV Cell Physics
   i. Optical absorption
   ii. Extrinsic semiconductors and the pn junction
   iii. Maximizing PV cell performance
   iv. Exotic junctions

7. Types of PV Cells
   i. Single crystal silicon
   ii. Multicrystalline silicon
   iii. Amorphous silicon cells
   iv. Exotic cells
   v. Emerging technologies

8. Additional topics as time permits
   i. PV cell panel life span
   ii. PV cell panel costs
   iii. Maintenance issues

Q. LABORATORY OUTLINE: None ☒ Yes ☐