A. Academic Division: Business, Industry, and Technology

B. Discipline: Engineering

C. Course Number and Title: ENGR1240 - Solar Power - Photovoltaic Energy

D. Course Coordinator: Randy Storms
   Assistant Dean: Daniel Wagner

Instructor Information:
- Name: Click here to enter text.
- Office Location: Click here to enter text.
- Office Hours: Click here to enter text.
- Phone Number: Click here to enter text.
- E-Mail Address: Click here to enter text.

E. Credit Hours: 3
   Lecture: 2 hours
   Laboratory: 2 hours

F. Prerequisites: EMMT2300

G. Syllabus Effective Date: Fall 2017

H. Textbook(s) Title:
   *Photovoltaic Systems*
   - Author(s): James P. Dunlop
   - Copyright Year:
   - ISBN #978-0826-9130-81

I. Workbook(s) and/or Lab Manual: None

J. Course Description: This course teaches how photovoltaic (PV) systems operate, how to determine the size of a PV system needed for a certain application, how to install and connect the PV system to the electrical grid.

K. College-Wide Learning Outcomes:

<table>
<thead>
<tr>
<th>College-Wide Learning Outcome</th>
<th>Assessments - - How it is met &amp; When it is met</th>
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</thead>
<tbody>
<tr>
<td>Communication – Written</td>
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<td>Communication – Speech</td>
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<td>Intercultural Knowledge and Competence</td>
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<td>Critical Thinking</td>
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<td>Information Literacy</td>
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<td>Quantitative Literacy</td>
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Updated: 2/14/2017
L. **Course Outcomes and Assessment Methods:**

Upon successful completion of this course, the student shall:

<table>
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<tr>
<td>1. Describe the available solar resource and conduct site assessments for PV installations.</td>
<td>Weeks 1-3: Graded homework for Chapters 1-3. Intro to Photovoltaic Systems/Solar Radiation/Site Surveys and Preplanning. All review questions graded. 3 weekly quizzes, Midterm and Final Exam. Download and install the NREL Homer Optimization Modeling software, and use it on 2 case studies. Interpret NREL solar radiation data sets. Use the Solar Pathfinder, and a compass, to complete site survey for the Kehoe Center. Calculate the required PV area given the panel efficiency and desired peak panel array power. Given a compass, azimuth-tilt-angle tables and magnetic declination data, calculate ideal panel angles for peak power. Prepare load analysis in Excel showing power rating, Average daily use and average daily energy use in Wh/Day.</td>
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<td>2. Analyze the performance and operating characteristics of PV systems and components.</td>
<td>Weeks 4-5: Chapters 4/5 – System Components &amp; Configurations/ Cells, Modules and Arrays. All review questions graded. 2 weekly quizzes, Midterm and Final Exam. Identify system components and Configurations, Cells, Modules and Arrays. Describe the function of each of the components of a grid tied and stand-alone PV systems. Week 6-8: Chapters 6/7/8-Batteries/Charge Controllers/Inverters. All review questions graded. 3 weekly Quizzes, Midterm and Final Exam. Labs for these 3 weeks will involve examination of the PV trainer built with Outback grid-tied components and their specifications, including a FLEXWare PV 8 Combiner, FLEXMax 60 Charge Controller and FX series inverter, and Kyocera 85W PV array.</td>
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<td>3. Diagram the appropriate code-compliant configurations for PV systems and equipment.</td>
<td>Weeks 1-13, Chapters 11/12/13 Electrical Integration/Utility Interconnection/Permitting &amp; Inspection. All review questions graded. 4 weekly quizzes, and Final Exam. (Students are required to take our NEC course as a prerequisite). Lab work will require determining safe disconnects, breakers/fuses, wire size/type, and safely and professionally wiring all system components of both a grid tied, stand-alone direct-tied and stand-alone regulated systems and safely integrating standby generators to a PV system.</td>
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<td>4. Design and plan PV system installations, including customer relations, developing performance expectations, responsibilities and schedules.</td>
<td>Week 3 &amp; Week 9: Chapters 3/9- Site Surveys and Preplanning/System Sizing. All review questions graded. 2 weekly quizzes, Midterm and Final Exam. Lab work will be based on Case Studies with presentations, development of the preliminary assessment, Site Survey, Preparing proposals, and installation planning.</td>
</tr>
<tr>
<td>5. Create and modify, as required, mechanical designs for PV systems that meet the performance, architectural and structural requirements for given applications.</td>
<td>Week 11: Chapter 11 – Mechanical Integration. All review questions graded. One quiz and Final Exam. Lab work will be based on Case Studies with presentations and involve consideration of the building, location, components, and other information collected from site surveys. Emphasis is placed on various types of mounting configurations, attachment methods, and structural loads.</td>
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## Outcomes

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<td>6. Create and modify, as required, electrical designs for PV systems that meet the safety, code-compliance and functional requirements for given applications.</td>
<td>Weeks 9-15: All Chapters/All labs. Quizzes, tests, and graded homework.</td>
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<td>7. Organize acceptance tests and inspections, and commission PV system installations.</td>
<td>Weeks 13/14 Chapters 13/14: Permitting and Inspection/Commissioning, Maintenance, and Troubleshooting. Quizzes, Final exam and lab work discussed above.</td>
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<td>8. Evaluate, troubleshoot, and maintain PV systems.</td>
<td>All previous weeks and Week 14: Chapter 14-Commissioning, Maintenance, and Troubleshooting. Quizzes, Final exam and lab work discussed above.</td>
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### M. Topical Timeline (Subject to Change):

1. Introduction to Photovoltaic Systems
2. Solar Radiation
3. Solar Insolation
4. Site Surveys and Preplanning
5. System Components and Configurations
6. Cell, Modules and Arrays
7. Batteries
8. Charge Controllers
9. Inverters
10. System Sizing
11. Mechanical Integration
12. Electrical Integration
13. Utility Interconnection
14. Permitting and Inspection
15. Commissioning, Maintenance, and Troubleshooting
16. Economic Analysis

### N. Course Assignments:

1. Homework: Selected problems and questions from weekly reading assignments must be completed.
2. Labs: Various self-paced and computer monitored labs administered in the IST lab.
3. Quizzes: Quizzes will be administered online via LMS.
4. Midterm: The midterm exam will be administered during week 8.
5. Final: There will be a comprehensive final at the end of the semester.

### O. Recommended Grading Scale:

<table>
<thead>
<tr>
<th>NUMERIC</th>
<th>GRADE</th>
<th>POINTS</th>
<th>DEFINITION</th>
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<tbody>
<tr>
<td>93–100</td>
<td>A</td>
<td>4.00</td>
<td>Superior</td>
</tr>
<tr>
<td>90–92</td>
<td>A-</td>
<td>3.67</td>
<td>Superior</td>
</tr>
<tr>
<td>87–89</td>
<td>B+</td>
<td>3.33</td>
<td>Above Average</td>
</tr>
<tr>
<td>83–86</td>
<td>B</td>
<td>3.00</td>
<td>Above Average</td>
</tr>
<tr>
<td>80–82</td>
<td>B-</td>
<td>2.67</td>
<td>Above Average</td>
</tr>
<tr>
<td>77–79</td>
<td>C+</td>
<td>2.33</td>
<td>Average</td>
</tr>
<tr>
<td>73–76</td>
<td>C</td>
<td>2.00</td>
<td>Average</td>
</tr>
</tbody>
</table>

Updated: 2/14/2017
P. Grading and Testing Guidelines:
Click here to enter text.

Q. Examination Policy:
Click here to enter text.

R. Class Attendance and Homework Make-Up Policy:
Click here to enter text.

S. Classroom Expectations:
Click here to enter text.

T. College Procedures/Policies:

Attendance Requirements: All students are required to attend all scheduled classes and examinations. Each faculty member has the right to establish regulations regarding attendance that he/she considers necessary for successful study.

Students who do not attend classes may be administratively withdrawn from those classes. However, failure to attend classes does not constitute withdrawal, and students are expected to process a formal withdrawal through the Student Records Office in Kee Hall.

Student engagement requirements: Student engagement is based on the “active pursuit” of learning which can be measured by class attendance, class participation (in class or online), taking required quizzes/examinations, and submission of work assignments or papers. Student engagement consists of a student attending at least 60% of the class sessions (there should be attendance throughout the term) and/or completing 75% of the assignments listed on the syllabus at the midpoint in the term. Exceptions can be made when there is on-going communication between the student and faculty member. The communication must be documented and the faculty member and student must be in agreement regarding the exception. Students not meeting the expectation will be administratively withdrawn from class. If a student believes he/she was administratively withdrawn in error, he/she may file an appeal. Being administratively withdrawn may have program and financial aid implications.

Academic Misconduct is any activity that tends to compromise the academic integrity of the college, or subvert the educational process. Examples of academic misconduct include, but are not limited to:

1. Violation of course or program rules as contained in the course syllabus or other information provided to the student; violation of program requirements as established by departments and made available to students.

2. Plagiarism including, but not limited to, submitting, without appropriate acknowledgment, any written, visual or oral material that has been copied in whole or in part from the work of others (whether such source is published or not) even if the material is completely paraphrased in one’s own words. This includes another individual’s academic composition, compilation, or other product, or a commercially
prepared paper. Plagiarism also includes submitting work in which portions were substantially produced by someone acting as a tutor or editor.

Such practices constitute plagiarism regardless of motive. Those who deny deceitful intent, claim not to have known that the act constituted plagiarism, or maintain that what they did was inadvertent are nevertheless subject to penalties when plagiarism has been confirmed.

3. **Cheating** and dishonest practices in connection with examinations, papers and projects, including but not limited to using unauthorized notes, study aids or information on an examination; obtaining help from another student during an examination; taking an exam or doing work for another student; providing one’s own work for another student to copy and submit as his/her own; or allowing another student to do one’s work and then submitting the work as one’s own. Also included would be altering a graded work after it has been returned, then submitting the work for re-grading; or submitting identical or similar papers for credit in more than one course without prior permission from the course instructors.

4. **Fabrication** including but not limited to falsifying or inventing any information, data or citation; presenting data that were not gathered in accordance with defined appropriate guidelines, and failing to include an accurate account of the method by which data were collected.

5. **Obtaining an Unfair Advantage** including, but not limited to stealing, reproducing, circulating, or otherwise gaining access to examination materials prior to the time authorized by the instructor; unauthorized collaborating on an academic assignment; taking, hiding or altering resource material; or undertaking any activity with the purpose of creating or obtaining an unfair advantage over another student’s academic work.

6. **Aiding and Abetting Academic Dishonesty** including, but not limited to providing material, information or other assistance to another person with the knowledge that such aid could be used in any of the violations stated above, or providing false information in connection with any inquiry regarding academic integrity.

7. **Alteration of Grades or Marks** including but not limited to, action by the student in an effort to change the earned credit or grade.

In addition, cases of academic dishonesty may involve photocopied materials. Materials used may fall under the Copyright Act. Violations of said Act may subject the user and/or the College to sanctions.

**Statement on Disabilities:** Any student who requires reasonable accommodations related to a disability should inform the course instructor and the Coordinator of Specialized Services (Room 138 in Kee Hall; phone 419-755-4727).

Students who encounter difficulty in any of their courses are encouraged to visit the Tutoring Resource Center (Room 119 in Fallerius Technical Education Center) for tutoring assistance, and the Student Success Center (Room 136 in Kee Hall) for academic assistance, advising services, referrals for personal counseling and Learning Disability (LD) Testing.

**Statement on Withdrawals:** As a student, you are expected to attend class. If you are unable or choose not to attend class, or if for whatever reason you are unable to keep up with the requirements of a course, you need to officially drop the class at the Student Records Office. Refund dates and withdrawal dates will vary slightly from term to term. Contact the Student Records Office for applicable dates. Additionally these dates are posted on the academic calendar available on the college’s website, [www.ncstatecollege.edu](http://www.ncstatecollege.edu), under the Academics heading on the home page and are available at the Student Records Office in Kee Hall. Students should go to the Student Records Office (Room 142 in Kee Hall) to process their withdrawal from any class.
If you choose to walk away from your class without officially withdrawing from it, the faculty member teaching the class must grade your classroom performance on the material available to him or her. This normally results in an "F" grade. An "F" grade can lower your grade point average considerably depending on the total credits accumulated.