ELCT 510 - Renewable Energy Technologies: Photovoltaic Devices and Systems

CREDITS/CONTACT HOURS: 3 Credits; 35 Contact hours (two 75-min classes per week)

INSTRUCTOR: Dr. Krishna C. Mandal

TEXTBOOKS AND OTHER REQUIRED MATERIAL:

SUPPLEMENTAL MATERIALS:
Lecture notes and course handouts (posted in Blackboard)

COURSE DESCRIPTION:
Lecture-based course provides an introduction to renewable energy. Particular attention will be paid to the photovoltaic solar systems. The course focuses on the physics behind these renewable energy technologies, devices being developed, efficiency and benefit analysis.

PREREQUISITES: ELCT 363 or equivalent recommended, but not required.

REQUIRED/ELECTIVE: Elective

TOPICS COVERED:
- Why energy sustainability is important
- Introduction to renewable energy, such as hydro, wind, wave, tidal and bioenergy
- Review of semiconductor physics and p-n junction
- Operation of photovoltaic solar cells and factors affecting conversion efficiency
- The terrestrial and space solar spectrum and solar radiance
- Photovoltaic materials and compound semiconductor solar cell design
- Components of photovoltaic systems- modules and balance of system

COURSE OUTCOMES:
A student who successfully fulfills the course requirements will:
1. Learn basic principles of different renewable energy technologies and their role in energy sustainability. (a, b, c, d, e, g, h, i, j, k)
2. Learn operating principle of photovoltaic solar cells and get familiarized with deferent parameters of solar cells. Understand methodology for evaluating solar cells performance. (a, b, c, e, g, k)
3. Understand essential tools for improving the efficiency of solar cells. (a, b, c, e, g, h, k)
4. Develop understanding of different photovoltaic materials; electronic and optical properties of semiconductor micro- and nanostructures. (a, b, c, e, h, i, j, k)

5. Learn how to calculate solar radiance and understand fundamentals of solar cell modules and balance of system to build a small solar panel. (a, b, c, e, h, k)

6. Learn how to conduct literature search, review and report findings; demonstrate teamwork and develop communication skill through group report and presentation. (b, d, e, g, i, k)

Relation of course outcomes to program outcomes:
H = major importance, M = moderate importance, L = minor importance, blank indicates no relation

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<tr>
<th>ABET Program Outcomes</th>
<th>Course Outcomes</th>
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<td>(a) an ability to apply knowledge of math, science and eng.</td>
<td>H   H   H   H   H</td>
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<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>M   H   H   M   H   M</td>
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<td>(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
<td>H   M   M   M   M</td>
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<td>(d) an ability to function on multidisciplinary teams</td>
<td>L   L   L   L   L   H</td>
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<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>M   M   M   L   M   M</td>
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<td>(g) an ability to communicate effectively</td>
<td>L   L   L   L   H</td>
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<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>M   M   M   M</td>
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<td>(i) a recognition of the need for, and an ability to engage in life-long learning</td>
<td>M   M   M   M</td>
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<td>(j) a knowledge of contemporary issues</td>
<td>M   M   M   M</td>
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<td>(k) an ability to use the techniques, skills, and modern eng. tool necessary</td>
<td>L   M   M   M   M   M</td>
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ASSESSMENT METHODS:

- Homework: Undergraduate 15% Graduate 10%
- Class Quizzes: Undergraduate 15% Graduate 10%
- Midterm Exam*: Undergraduate 20% Graduate 20%
- Final Exam*: Undergraduate 30% Graduate 30%
- Project*: Undergraduate 10% Graduate 15%
(Solar cell testing, performance evaluation and solar array design)
- Group Report and Presentation: Undergraduate 10% Graduate 15%
(Working in groups, students will research a topic in renewable energy technologies and present their understanding to the class)

*Graduate students’ evaluation will include advanced problems and a research component.
Letter grades will be assigned as follows:

- score $\geq$90: A
- $85 \leq$ score <90: B+
- $80 \leq$ score <85: B
- $75 \leq$ score <80: C+
- $70 \leq$ score <75: C
- $60 \leq$ score <70: D
- score <60: F