EE - 4231  
Physical Electronics

Curricular Designation:  EE: elective  
CpE: elective

Catalog Description:
EE 4231 – Physical Electronics  
Device physics and physical models of the most basic solid-state device structures. Major topics include the terminal characteristics and their physical origin, device design, and device applications.  
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall  
Prerequisites: EE 3131

Textbooks(s) and/or Other Required Materials:

Prerequisites by Topic:
1. Basic concepts of semiconductor devices
2. Circuit applications of semiconductor devices
3. Atomic view of matter and radiation

Course Objectives:
1. Familiarity with the lattice structures, energy band diagrams of metals, semiconductors and insulators, direct band gap vs. indirect band gap semiconductors
2. Mastery of the carrier statistics and dynamics in intrinsic and extrinsic semiconductors
3. Mastery of the origin of current-voltage characteristics of diodes and transistors
4. Familiarity with device cross sections and device design and fabrication

Topics Covered:
1. Crystal Properties of Semiconductors
2. Quantum Mechanics of Atoms and Electrons
3. Energy Bands and Charge Carriers in Semiconductors
4. Excess Carriers in Semiconductors
5. PN Junctions, Metal-Semiconductor Junctions
7. Advanced MOSFET Structures

Relationship of the Course Content to Program Outcomes:
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Topics and Level of Coverage</th>
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<tbody>
<tr>
<td>a an ability to apply knowledge of mathematics, science and engineering</td>
<td>Important</td>
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<tr>
<td>b an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>x</td>
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<tr>
<td>c the ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability and sustainability</td>
<td>x</td>
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<td>d an ability to function on multi-disciplinary teams</td>
<td>x</td>
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<td>e an ability to identify, formulate and solve engineering problems</td>
<td>x</td>
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<td>f an understanding of professional and ethical responsibility</td>
<td>x</td>
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<td>g an ability to communicate effectively</td>
<td>x</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>
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<td>i a recognition of the need for, and an ability to engage in life-long learning</td>
<td>x</td>
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<td>j a knowledge of contemporary issues</td>
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<td>k the ability to use the techniques, skills, and modern engineering tools necessary for the practice of electrical engineering</td>
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**Contribution of Course to Meeting Degree Requirements:**
3 Credit Hours – Engineering Topics

**Class/Laboratory Schedule** (note: 1 hour = 50 minutes):
Lecture: 42 hours = 3 hours/week for 14 weeks

**Prepared by:**
Elena Semouchkina, Associate Professor, November 30, 2016