

## Subject Description Form

<b>Subject Code</b>	EIE577
<b>Subject Title</b>	Optoelectronic Devices
<b>Credit Value</b>	3
<b>Level</b>	5
<b>Pre-requisite/ Co-requisite/ Exclusion</b>	Nil
<b>Objectives</b>	<p>The aim of this course is to introduce to the students to the fundamentals of semiconductor optoelectronic devices. These include pn junctions, light emitting diodes (LEDs) and solar cells. These devices have found important commercial applications. Upon completion of the subject, the students will be able to understand:</p> <ol style="list-style-type: none"> <li>1. wave mechanics;</li> <li>2. principles of semiconductor materials;</li> <li>3. operating principles of PN junctions;</li> <li>4. operating principles of LEDs; and</li> <li>5. principles of semiconductor solar cells and photodetectors.</li> </ol>
<b>Intended Learning Outcomes</b>	<p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> <li>a. understand the principles of semiconductor materials including some basic ideas of quantum mechanics;</li> <li>b. understand the operating principles of semiconductor optoelectronic devices;</li> <li>c. fabricate semiconductor devices.</li> </ol>
<b>Subject Synopsis/ Indicative Syllabus</b>	<ol style="list-style-type: none"> <li>1. <u>Elements of Wave Mechanics</u> The Bohr atom. Wave-particle duality. General Formulation. Particle in a 1-D box.</li> <li>2. <u>Basic Energy Band Theory</u> The Bloch theorem. Kronig-Penny model. Energy bands and Brillouin zones. Particle motion and effective mass. <math>E-k</math> diagrams. Band gap energy</li> <li>3. <u>Semiconductor fundamentals</u> Basics of electrical and optical properties of semiconductor materials. P-N junctions.</li> <li>4. <u>Semiconductor LEDES</u> Operation principles of LEDs. Human vision, photometry and colorimetry. White solid-state lamps – phosphor conversion versus multichip LEDs, Display fundamentals.</li> <li>5. <u>Solar Cells and photodetectors</u> Operation principles of solar cells. Silicon-based solar cells, compound semiconductor based solar cells.</li> </ol>

<b>Teaching/Learning Methodology</b>	<p>The basic principles of semiconductor, quantum mechanics, and the operating principles of semiconductor optoelectronic devices will be discussed and explained in lectures. Lab sessions will be organized for students to experience the fabrication processes for a basic pn junction photovoltaic cell. Students will write an essay of a topic selected by the student himself/herself. At the end of the semester each student has to give a 15 to 20-minute presentation on his/her selected topic.</p> <table border="1"> <thead> <tr> <th>Teaching/Learning Methodology</th> <th colspan="3">Intended Subject Learning Outcomes</th> </tr> <tr> <td></td> <th>a</th> <th>b</th> <th>c</th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td>✓</td> <td>✓</td> <td></td> </tr> <tr> <td>Laboratory</td> <td></td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Term paper</td> <td>✓</td> <td>✓</td> <td></td> </tr> </tbody> </table>				Teaching/Learning Methodology	Intended Subject Learning Outcomes				a	b	c	Lectures	✓	✓		Laboratory		✓	✓	Term paper	✓	✓																	
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<b>Assessment Methods in Alignment with Intended Learning Outcomes</b>	<table border="1"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th> <th rowspan="2">% weighting</th> <th colspan="3">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> </tr> </thead> <tbody> <tr> <td>1. Homework &amp; Quizzes</td> <td>20%</td> <td>✓</td> <td>✓</td> <td></td> </tr> <tr> <td>2. Laboratory</td> <td>20%</td> <td></td> <td>✓</td> <td>✓</td> </tr> <tr> <td>3. Mid-term test</td> <td>30%</td> <td>✓</td> <td>✓</td> <td></td> </tr> <tr> <td>4. Term paper and presentation</td> <td>30%</td> <td>✓</td> <td>✓</td> <td></td> </tr> <tr> <td>Total</td> <td>100%</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p> <ol style="list-style-type: none"> <li><b>Laboratory:</b> Students will learn the semiconductor devices fabrication process in the laboratory sessions. The laboratory reports will reflect their understanding of the processes. [Outcomes (b) and (c)]</li> <li><b>Term Paper and Presentation:</b> Students will need to conduct literature research on different optoelectronic devices, investigate the operating principles of the devices and to summarize the findings in a paper. [Outcomes (a) and (b)]</li> <li><b>Homework &amp; Quizzes:</b> The homework and quizzes will cover the fundamental quantum mechanics, physics of semiconductor materials and devices. [Outcomes (a) and (b)]</li> <li><b>Mid-term test:</b> The mid-terms will mainly cover the fundamental quantum mechanics, physics of semiconductor materials and devices principles. [Outcomes (a) and (b)]</li> </ol>				Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			a	b	c	1. Homework & Quizzes	20%	✓	✓		2. Laboratory	20%		✓	✓	3. Mid-term test	30%	✓	✓		4. Term paper and presentation	30%	✓	✓		Total	100%						
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<b>Reading List and References</b>	<ol style="list-style-type: none"><li>1. Advanced Semiconductor Fundamentals, 2nd Edition. Robert F. Pierret, Prentice Hall, 2003.</li><li>2. Semiconductor Devices – Physics and Technology. 3rd Edition. S.M. Sze &amp; M.K. Lee. John Wiley &amp; Sons, Inc. 2012.</li><li>3. The Physics of Solar Cells. J. Nelson. Imperial College Press. 2003</li><li>4. Physics of Semiconductor Devices, S.M. Sze, Kwok K. Ng, 3rd Edition. John Wiley &amp; Sons, Inc. 2007</li><li>5. Fundamentals of solid-state lighting: LEDs, OLEDs, and their applications in illumination and displays. Vinod Kumar Khanna. CRC Press 2014</li></ol>
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