Subject Description Form

Subject Code	EIE577
Subject Title	Optoelectronic Devices
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	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: 1. wave mechanics; 2. principles of semiconductor materials; 3. operating principles of PN junctions; 4. operating principles of LEDs; and 5. principles of semiconductor solar cells and photodetectors.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the principles of semiconductor materials including some basic ideas of quantum mechanics; b. understand the operating principles of semiconductor optoelectronic devices; c. fabricate semiconductor devices.
Subject Synopsis/ Indicative Syllabus	1. Elements of Wave Mechanics The Bohr atom. Wave-particle duality. General Formulation. Particle in a 1-D box. 2. Basic Energy Band Theory The Bloch theorem. Kronig-Penny model. Energy bands and Brillouin zones. Particle motion and effective mass. E-*k* diagrams. Band gap energy 3. Semiconductor fundamentals Basics of electrical and optical properties of semiconductor materials. P-N junctions. 4. Semiconductor LEDS Operation principles of LEDs. Human vision, photometry and colorimetry. White solid-state lamps – phosphor conversion versus multichip LEDs, Display fundamentals. 5. Solar Cells and photodetectors Operation principles of solar cells. Silicon-based solar cells, compound semiconductor based solar cells.

Teaching/Learning Methodology

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.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	
Laboratory		✓	✓
Term paper	✓	✓	

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Assignment & Quizzes	20%	✓	✓	
2. Laboratory	20%		✓	✓
3. Course test	30%	✓	✓	
4. Term paper and presentation	30%	✓	✓	
Total	100%			

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

1. **Laboratory**: 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)]
2. **Term Paper and Presentation:** 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)]
3. **Assignment & Quizzes:** The assignment and quizzes will cover the fundamental quantum mechanics, physics of semiconductor materials and devices. [Outcomes (a) and (b)]
4. **Course test:** The course test, which will be conducted in class, covers the main content in this subject, including the fundamental quantum mechanics, physics of semiconductor materials and devices principles, etc. [Outcomes (a) and (b)]

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	4 Hrs.
▪ Laboratory	9 Hrs.
Other student study effort:	
▪ Self-study	39 Hrs.
▪ Laboratory reports	10 Hrs.
▪ Term paper	20 Hrs.
Total student study effort	108 Hrs.

Reading List and References	1. Advanced Semiconductor Fundamentals, 2nd Edition. Robert F. Pierret, Prentice Hall, 2003. 2. Semiconductor Devices – Physics and Technology. 3rd Edition. S.M. Sze & M.K. Lee. John Wiley & Sons, Inc. 2012. 3. The Physics of Solar Cells. J. Nelson. Imperial College Press. 2003 4. Physics of Semiconductor Devices, S.M. Sze, Kwok K. Ng, 3rd Edition. John Wiley & Sons, Inc. 2007 5. Fundamentals of solid-state lighting: LEDs, OLEDs, and their applications in illumination and displays. Vinod Kumar Khanna. CRC Press 2014

July 2023