**City University of Hong Kong**
**Course Syllabus**

**offered by Department of Electrical Engineering**
**with effect from Semester A in 2021/2022**

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## Part I Course Overview

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|---|---|
| **Course Title:** | Applied Optoelectronic Devices |
| **Course Code**: | EE3115 |
| **Course Duration:** | One Semester (13 weeks) |
| **Credit Units**: | 3 |
| **Level**: | B3 |
| **Proposed Area:** *(for GE courses only)* | ☐ Arts and Humanities<br>☐ Study of Societies, Social and Business Organisations<br>☐ Science and Technology |
| **Medium of Instruction:** | English |
| **Medium of Assessment:** | English |
| **Prerequisites**: *(Course Code and Title)* | EE2005 Electronic Devices and Circuits<br>or<br>EE2301 Basic Electronic Circuits |
| **Precursors**: *(Course Code and Title)* | Nil |
| **Equivalent Courses**: *(Course Code and Title)* | Nil |
| **Exclusive Courses**: *(Course Code and Title)* | Nil |

**Part II Course Details**

## 1. Abstract

The course aims to provide students with a more thorough understanding of semiconductor and optoelectronic principles.

## 2. Course Intended Learning Outcomes (CILOs)

*(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)*

| No. | CILOs[#] | Weighting* (if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|---|---|---|---|---|---|
| | | | *A1* | *A2* | *A3* |
| 1. | To identify the characteristics of semiconductor and optoelectronic materials | | √ | √ | |
| 2. | To study the working mechanisms of various junction devices. | | √ | √ | |
| 3. | To describe light modulation schemes through polarization control | | √ | √ | |
| 4. | To apply these devices in optical communication systems | | √ | √ | |
| | ** If weighting is assigned to CILOs, they should add up to 100%.* | 100% | | | |

*[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.*

*A1: Attitude*
*Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.*

*A2: Ability*
*Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.*

A3: *Accomplishments*
*Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.*

## 3. Teaching and Learning Activities (TLAs)

*(TLAs designed to facilitate students' achievement of the CILOs.)*

| TLA | Brief Description | CILO No. | | | | | | Hours/week (if applicable) |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | | | |
| Lectures | Key concepts are described and illustrated | √ | √ | √ | √ | | | 2 hrs/wk |
| Tutorials | Key concepts are worked out based on problems | √ | √ | √ | √ | | | 1 hrs/wk |
| Laboratories | Key concepts are applied to build practical circuits | √ | √ | | √ | | | 3 hrs/wk (3 weeks) |

**4. Assessment Tasks/Activities (ATs)**

*(ATs are designed to assess how well the students achieve the CILOs.)*

| Assessment Tasks/Activities | CILO No. | | | | | | Weighting* | Remarks |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | | | | |
| Continuous Assessment: 50% | | | | | | | | |
| Tests (min.: 2) | ✓ | ✓ | ✓ | ✓ | | | 30% | |
| #Assignments (min.: 3) | ✓ | ✓ | ✓ | ✓ | | | 10% | |
| Lab Exercises/Reports | ✓ | ✓ | | ✓ | | | 10% | |
| Examination: 50% (duration: 2 hrs , if applicable) | | | | | | | | |
| Examination | ✓ | ✓ | ✓ | ✓ | | | 50% | |
| ** The weightings should add up to 100%.* | | | | | | | 100% | |

**Remark:**

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained.

# may include homework, tutorial exercise, project/mini-project, presentation

**5. Assessment Rubrics**

*(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)*

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B, B-) | Fair (C+, C, C-) | Marginal (D) | Failure (F) |
|---|---|---|---|---|---|---|
| 1. Examination | Achievements in CILOs | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 2. Coursework | Achievements in CILOs | High | Significant | Moderate | Basic | Not even reaching marginal levels |

## 6. Constructive Alignment with Major Outcomes

| MILO No. | How the course contribute to the specific MILO(s) |
|---|---|
| 1 | An ability to apply knowledge of mathematics, science and engineering. |
| 3 | An ability to design a system or process that conforms to a given specification within realistic constraints. |
| 5 | An ability to identify, evaluate, formulate and solve engineering problems. |

**Part III Other Information** (more details can be provided separately in the teaching plan)

## 1. Keyword Syllabus

Introduction to Semiconductor Physics and Optoelectronic Materials

Introduction to semiconductor physics. Crystal structures. Metals, insulating and semiconductor. Properties of common direct and indirect band gap semiconductors. Fermi-Dirac distribution function. Carrier concentrations. Conductivity and mobility of carriers. Drift and diffusion of carriers. Injection, generation and recombination of carriers. Optical polarizers. Birefringent materials.

Junction Devices

pn-junction under equilibrium, forward and reverse bias conditions. Charge storage and transient behaviour:- junction and diffusion capacitances. Junction breakdown:- Zener and avalanche effects. Schottky diode. Rectifying and ohmic contacts..

Applications of Semiconductor and Optoelectronic Devices

Photodetectors. Solar cells. Light emitting diode. Laser diodes. Light modulation device through polarization control. Liquid Crystal display, passive and active matrix. Thin-film transistors.

Basic introduction to optical link system

Geometric optics treatment of light propagation in optical fibres, acceptance angle, numerical aperture. Brief introduction to single-mode and multimode fibres. Basic concept of modal, material and waveguide dispersion.

**Laboratory Experiment:**

Unit 1 Photoresistor Sensor Experiment
Unit 2 Solar Cell Experiment
Unit 3 Basic Optical link Experiments

## 2. Reading List

### 2.1 Compulsory Readings

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

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|---|---|
| 1. | S.O. Kasap: Optoelectronic and Photonics. (Prentice-Hall) |

### 2.2 Additional Readings

*(Additional references for students to learn to expand their knowledge about the subject.)*

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|---|---|
| 1. | Ben G Streetman: Solid State Electronic Devices. (Prentice Hall) |
| 2. | Robert F. Pierret: Semiconductor Device Fundamentals. (Addison Wesley) |