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

**offered by Department of Electrical Engineering**
**with effect from Semester A 2024 / 2025**

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## Part I Course Overview

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|---|---|
| **Course Title:** | Meta-device and Photonic System Analysis |
| **Course Code**: | EE5439 |
| **Course Duration:** | One Semester (13 weeks) |
| **Credit Units**: | 3 |
| **Level**: | P5 |
| **Medium of Instruction:** | English |
| **Medium of Assessment:** | English |
| **Prerequisites**: *(Course Code and Title)* | Nil |
| **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 aim of the course is to provide students with theoretical knowledge, simulation modeling, and analytical skills necessary for an in-depth understanding of photonic system of optoelectronics and meta-devices. Major topics include antenna design, the interaction between electromagnetic waves and matter, and property analysis for nanostructures, meta-devices and photonic systems.

### 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. | Explain the principles of electromagnetic waves and Fundamental concepts of meta-devices and photonic systems. | | ✓ | ✓ | |
| 2. | Apply photonic system analysis techniques to meta-devices and photonic systems. | | ✓ | ✓ | |
| 3. | Design and analyse meta-devices and photonic systems for specific functions and visualization of simulated results. | | ✓ | ✓ | ✓ |
| 4 | Perform independent studies to identify the potential applications and innovations of meta-devices and advanced photonic systems. | | ✓ | ✓ | ✓ |
| | | 100% | | | |

*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 real-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. Learning and Teaching Activities (LTAs)

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

| LTA | Brief Description | CILO No. | | | | | | Hours/week (if applicable) |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | | | |
| Lecture and Tutorial | Knowledge of the general concepts in photonic systems and their applications; practice simulation modeling and analysis. | ✓ | ✓ | ✓ | ✓ | | | 3 hrs/wk for 13 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 % | | | | | | | | |
| Test (> 2 times) | ✓ | ✓ | ✓ | ✓ | | | 26% | |
| Assignments (> 3 times) | ✓ | ✓ | ✓ | ✓ | | | 12% | Includes homework, tutorial exercises, and in-class exercises. |
| Reports/Project | | ✓ | ✓ | ✓ | | | 12% | Includes reports, project, mini-project, and presentation. |
| Examination: 50 % (duration: 2 hrs ) | | | | | | | | |
| Examination | ✓ | ✓ | ✓ | ✓ | | | 50% | |
| | | | | | | | 100% | |

**Remark:**

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

## 5. Assessment Rubrics

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

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

| 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 level |
| 2. Coursework | Achievements in CILOs | High | Significant | Moderate | Basic | Not even reaching marginal level |

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B,) | Marginal (B-, C+, C) | Failure (F) |
|---|---|---|---|---|---|
| 1. Examination | Achievements in CILOs | High | Medium | Low | Not even reaching marginal level |
| 2. Coursework | Achievements in CILOs | High | Medium | Low | Not even reaching marginal level |

## 6. Constructive Alignment with Programme Outcomes

| PILO | How the course contributes to the specific PILO(s) |
|---|---|
| 1,2,3,4 | Students are required to apply the fundamental theoretical knowledge and analytical skills for an in-depth understanding of meta-devices and photonic systems. The students will formulate and solve problems using the learnt knowledge and skills. |
| 2,3,4,5 | Students are required to complete an independent research study on new developments of meta-devices and photonic systems. |
| 6 | Students are required to give an oral presentation of their independent projects. |

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

## 1. Keyword Syllabus

*(An indication of the key topics of the course.)*

- Fundamental concepts of photonics
- Basic principle of meta-devices
- Overview of photonic systems
- Design, fabrication, characterization and application of meta-devices
- General meta-device and photonic system analysis techniques
- Simulation modelling, parameters setting, and result verification
- Visualization and analysis of simulated results
- Case study: simulation of meta-devices and photonic systems

## 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.)*

| | |
|---|---|
| 1. | Course notes provided by the instructor |

### 2.2 Additional Readings

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

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| 1. | Roger W. Pryor, Multiphysics Modeling Using COMSOL 5 and MATLAB, 2022 |
| 2. | Layla S. Mayboudi, Geometry Creation and Import With COMSOL Multiphysics (Multiphysics Modeling Series), 2019. |
| 3. | Slawomir Sujecki, Photonics Modeling and Design, 2014 |
| 4 | Sophocles Orfanidis, Electromagnetic Waves and Antennas, 2016. |
| 5. | Merhzad Tabatabaian, COMSOL5 for Engineers, 2015. |
| 6. | Levent Sevgi, Electromagnetic Modeling and Simulation, 2014. |