City University of Hong Kong
Course Syllabus

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

Part I Course Overview

Course Title:	Fundamentals and Applications of Photonics
Course Code:	EE5436
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)*	EE2104 Introduction to Electromagnetics
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The course aims to help the student to learn the basic principles of photonics technology, the most popular optical devices, and their applications in optical communication, next generation microprocessor, and biomedical sensing.

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 fundamental principles of photonic technology.		√		
2.	Apply electromagnetic theories to understand the working principles of photonic components.		√		
3.	Independently design photonic devices for specific tasks.		√	√	
4.	Identify and explain the applications of different photonic devices.		√	√	
5.	Perform independent studies to identify future developments of photonic technologies.		√	√	√
		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	5		
Lecture	Learn and understand the fundamental theories, important concepts and major applications of photonic devices.	√	√	√	√			2 hrs/wk (for 11 weeks)
Tutorial	Work out important concepts based on problems and discussions	√	√	√	√			1 hr/wk (for 11 weeks)
Project	Research selected photonic technology topics and provide independent evaluations.			√	√	√		3 hr/wk (for 2 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	5			
Continuous Assessment: 50%								
Tests (min.: 1)	√	√	√	√			25%	
#Assignments (min.: 3)	√	√	√	√			10%	
Project	√	√	√	√	√		15%	
Examination: 50% (duration: 2 hrs , if applicable)								
Examination	√	√	√	√			50%	
							100%	

Remark:

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

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.)

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 contribute to the specific PILO(s)
1, 2, 3	Students are required to apply the fundamental theoretical knowledge and analytical skills for an in-depth understanding of the working principles and applications of photonic technologies.
4	Students are required to complete an independent research study on new developments of photonic technologies.
6	Students are required to give an oral presentation of their independent research studies.

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

1. Keyword Syllabus

Ray Optics
- Basic concepts of ray optics: refraction, reflection, Snell's law, total internal reflection
- Basic optical components: mirrors, prisms, lenses
- Transfer matrix method

Wave and Beam Optics
- Electromagnetic theory of light
- Polarization states of light
- Absorption, dispersion, phase and group velocity
- Gaussian beam, beam shaping components

Guided-Wave Optics
- Planar mirror waveguides
- Planar dielectric waveguides, 2D dielectric waveguides, effective index theory
- Coupled-mode theory

Integrated Photonics
- Basic integrated photonic waveguides: rib, ridge waveguides
- Arrayed-waveguide gratings, Mach-Zehnder interferometers, waveguide tapers

Resonator Optics
- Fabry-Perot resonators
- Microring resonators, microring-based filters

Nonlinear Optics & Electro-Optics
- Basic principles and concepts of nonlinear optics
- Theory of second harmonic generation
- Theory and applications of electro-optic modulation

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.	B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, Wiley, 1990

2.2 Additional Readings

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

1.	A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, 6th Edition, Oxford University Press, 2007.
2.	L. Novotny and B. Hecht, Principles of Nano-Optics, Cambridge University Press, 2012.