City University of Hong Kong
Course Syllabus

offered by Department of Physics
with effect from Semester B 2017 / 2018

Part I Course Overview

Course Title:	**Photonics in Nanomaterial Systems and Devices**
Course Code:	**AP6181**
Course Duration:	One semester
Credit Units:	**3**
Level:	**P6**
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)*	**AP8181 Photonics in Nanomaterial Systems and Devices**

Part II Course Details

1. Abstract

To use the principles of physical optics and light-matter interaction to study the optical properties of materials and optical devices. To explore and discuss applications of the course's topics in science and technology and to explore the principles and applications of nano-optics and nano-photonics.

Upon successful completion of the course, students are expected to be equipped with sufficient knowledge to discuss the different techniques used to study the interaction of light with mater, to explain the basic microscopic processes that describe the propagation of light in different media as it relates to propagation, absorption, and emission processes, and to develop a working knowledge in the application of selected photonic and optical material systems and devices.

The students will be able to rationalize and explain the applications of the course contents to modern practical scientific and technological applications with emphasis in nanomaterials and nanotechnology.

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.	Identify the physical principles involved in optical characterization systems.	25%	√		
2.	Describe the microscopic phenomena that occur during the propagation of light and the basic models that explain it.	25%		√	
3.	Use the principles of Fourier analysis and Fourier optics and describe its applications and importance.	25%			√
4	Explain the principles of near field optics and its applications to nano-photonics.	25%	√		√
		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 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		
1	Lectures	√	√	√	√		16 hrs/8 weeks
2	Small class Activities	√	√				8 hrs/8 weeks
3	Laboratory Exercise		√	√			12 hrs/4 weeks
4	Group project and presentation			√	√		3 hrs/1 week

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 %								
Laboratory reports		√	√				15%	
Mid-term Test	√						15%	
Mini Project and Report		√	√	√			20%	
Examination: 50 % (duration: 2 hrs)								
							100%	

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. Laboratory reports	Understand and explaining the methodology. Ability to identify experimental problems. Ability to find solutions to problem occurred.	High	Significant	Moderate	Basic	
2. Mid-Term test	Understand concepts of ray, wave, near-field optics, and their use for the characterization of materials and design of device applications.	High	Significant	Moderate	Basic	
3. Final project and report	Ability to select a project, design a protocol to address it, and advance its resolution. Demonstrate a curiosity driven approach to self-study and capacity to understand and explain new concepts.	High	Significant	Moderate	Basic	
4. Examination	Knowledge of the fundamental course contents including concepts of ray, wave, near-field optics, and light-matter interaction, and their use for the characterization of materials and design of device applications.	High	Significant	Moderate	Basic	

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.)

- Introduction and overview of principles of geometrical and wave optics: basic equations and concepts including optical cavities, polarization, coherence, laser beams, diffraction, and interference.
- Propagation of light: rarefied and dense media, Huygens' and Fermat's principle, speed of light, refractive index, Fresnel equations.
- Optical properties of solids: Lorentz Oscillator Model (semiconductors), Drude model (metals).
- Fourier series and Fourier integral: concepts of coherence, correlation, and convolution. Fourier transform spectroscopy, and applications to FTIR and related vibrational spectroscopies.
- Characterization of materials: transmission and reflection, ellipsometry, absorption, photoluminescence, and cathodoluminescence.
- Introduction to photonics and nano-optics: evanescent fields, propagation and focusing of optical fields, surface plasmons, optical antennae.
- Selected applications of modern nano-photonic devices (e.g., harnessing near-field optical techniques, plasmonic lasers, surface plasmons for biosensing applications).

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.	E Hecht, Optics, 4th edition, (Addison Wesley 2002). Reading MA.
2	Tigran V. Shahbazyan, Mark I. Stockman (Eds.), Plasmonics: Theory and Applications, Springer, 2013.
3.	S O Kasap, Optoelectronic and photonics: principles and practices, Prentice Hall, 2001.

2.2 Additional Readings

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

1.	L Novotny and B Hetch, Principles of nano-optics Cambridge University Press, 2006
2.	Motoichi Ohtsu [et al.] Principles of nanophotonics CRC Press/Taylor & Francis,
3.	M Ohtsu (Eds.) Nanophotonics and nanofabrication Weinheim : Wiley-VCH, c2009.
4	Baldassare Di Bartolo and John Collins (Eds.), Biophotonics: spectroscopy, imaging, sensing, and manipulation.