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:	Applications of Lasers in Optoelectronics
Course Code:	EE5432
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)*	EE4035 Optical Communication; or EE4142 Guided Wave Optoelectronics; or equivalent
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	EE4105 Laser Applications

Part II Course Details

1. Abstract

This course aims to provide students with an understanding of laser theories, design considerations, operation dynamics, and applications of lasers in optoelectronics, which stimulates interests in learning the latest development in optoelectronic technologies.

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.	Describe optoelectronic applications of lasers and match the types of lasers to the applications.				
2.	Analyze the designs of different laser oscillators and examine the output performances.			✓	
3.	Discuss the dynamic operations of lasers.				
4.	Describe research developments of novel laser devices.		✓		
5.	Characterize different lasers commonly used in optoelectronics.				
		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	Students will engage in lectures on the subject matter for the whole class.	✓	✓	✓	✓	✓		2 hrs/wk (for 11 weeks)
Tutorial and in-class exercise (including a presentation)	Students will engage in working out solutions to the examples on selected topics. The presentation is designed to encourage students to research into individual topics including engineering applications of lasers, popular lasers, or novel lasers.	✓	✓	✓	✓	✓		1 hr/wk (for 11 weeks)
Laboratory	Students will participate in laboratories distributed over the semester.					✓		3 hrs / 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: 30%								
Assignments including laboratories (min. 3)	✓	✓	✓	✓	✓		15%	
Test(s)	✓	✓	✓	✓	✓		15%	
Examination: 70% (duration: 2hrs , if applicable)								
Examination	✓	✓	✓	✓	✓		70%	
							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.

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 in 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, 4	The application of current knowledge in optoelectronics to laser technology, specialized knowledge in laser dynamics, and evaluation of anticipated trends in laser applications are central to the aim of this course.

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

1. Keyword Syllabus

Introduction: Light-matter interaction, unique properties of laser, survey of novel laser applications

Fundamental Optoelectronics:Ray matrix, Gaussian beams, optical cavities, Schrodinger equation, harmonic oscillators, perturbation theory, density matrix, optical susceptibility

Laser Theory: Semi-classical rate equations, detailed balancing, population inversion, linewidth broadening

Laser Dynamics: Continuous-wave, modulation, Q-switching, mode-locking, injection-locking, optical chaos

Laser Applications: Optical communication, detection and ranging, biomedical applications

Novel Laser: Quantum dot lasers, quantum cascade lasers

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.	A. Yariv, Quantum Electronics, 3/e, Wiley (1989)
2.	J. M. Liu, Photonic Devices, Cambridge University Press (2005)

2.2 Additional Readings

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

1.	R. L. Liboff, Introductory Quantum Mechanics, 3/e, Addison-Wesley (1997)
2.	J. T. Verdeyen, Laser Electronics, 3/e, Prentice Hall (1995)
3.	W. T. Silfvast, Laser Fundamentals, Cambridge University Press (1996)