EE5432: APPLICATIONS OF LASERS IN OPTOELECTRONICS

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Applications of Lasers in Optoelectronics

Subject Code
EE - Electrical Engineering
Course Number
5432

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
EE4035 Optical Communication; or EE4142 Guided Wave Optoelectronics; or equivalent

Equivalent Courses
Nil

Exclusive Courses
EE4105 Laser Applications

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-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.			x	
3	Discuss the dynamic operations of lasers.				
4	Describe research developments of novel laser devices.		x		
5	Characterize different lasers commonly used in optoelectronics.				

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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Students will engage in lectures on the subject matter for the whole class.	1, 2, 3, 4, 5	2 hrs/wk (for 11 weeks)
2	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, 2, 3, 4, 5	1 hr/wk (for 11 weeks)
3	Laboratory	Students will participate in laboratories distributed over the semester.	5	3 hrs/wk (for 2 weeks)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments including laboratories (min. 3)	1, 2, 3, 4, 5	15	
2	Test(s)	1, 2, 3, 4, 5	15	

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

2

Additional Information for ATs

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.

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task

Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Additional Information for AR
Constructive Alignment with Programme Outcomes

PILO 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

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

Reading List

Compulsory Readings

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

Additional Readings

	Title
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)