EE4105: PRINCIPLES OF LASERS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Principles of Lasers

Subject Code
EE - Electrical Engineering
Course Number
4105

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
EE2104 Introduction to Electromagnetics

Precursors
EE3109 Applied Electromagnetics

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to provide students with an understanding of the basic principles, operation characteristics, and photonics applications of lasers.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the applications of lasers in photonics technology		x	x	
2	Describe the basic operation of laser oscillators		x	x	
3	Relate the appropriate properties of lasers to different applications		x	x	
4	Apply basic laser theories on operational characteristics		x	x	

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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Lecture on the subject matter for the whole class. In-class exercises would provide short questions for fostering the learning experience	1, 2, 3, 4	3 hrs/wk
2	Laboratory	Laboratories distributed over the semester.	1, 2, 3, 4	3 hrs/wk (for 2 weeks)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	30	
2	#Assignments (min.: 3)	1, 2, 3, 4	10	
3	Lab Exercises/Reports	1, 2, 3, 4	10	

Continuous Assessment (%)

50

Examination (%)
50

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.

may include homework, tutorial exercise, project/mini-project, presentation

Assessment Rubrics (AR)

Assessment Task
Examination

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 levels

Assessment Task
Coursework

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 levels

Part III Other Information

Keyword Syllabus
Introduction: Electromagnetic waves, photons, laser radiation, applications
Basic Optics: Ray optics, wave optics, optical cavities, transverse and longitudinal modes
Optical Materials: Stimulated emission, population inversion, lineshapes
Laser Principles: Pumping schemes, continuous-wave operation, pulsed operation, modulation
Common Lasers: Solid-state lasers, gas lasers, fiber lasers, semiconductor lasers
Applications of Lasers: Optical communication, biomedical imaging

Reading List

Compulsory Readings

	Title
1	J. M. Liu, Photonic Devices, Cambridge University Press (2005)
2	J. T. Verdeyen, Laser Electronics, 3/e, Prentice Hall (1995)

Additional Readings

	Title
1	G. P. Agrawal and N. K. Dutta, Semiconductor Lasers, 2/e, Van Nostrand Reinhold (1993)
2	A. E. Siegman, Lasers, University Science Books (1986)