EE4142: INTRODUCTION TO INTEGRATED PHOTONICS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Integrated Photonics

Subject Code
EE - Electrical Engineering
Course Number
4142

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

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the fundamental operating principles of integrated photonics technology.		x	x	
2	Identify the applications of different integrated photonic devices.		x	x	
3	Apply the basic optical theories to design simple integrated photonic devices.		x	x	
4	Describe the basic operation and applications of integrated photonic devices.		x	x	
5	Operate some commonly used integrated photonic devices.		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	Important concepts are described and explained/ illustrated. Important concepts are worked out based on problems and discussions.	1, 2, 3, 4, 5	3 hrs/wk
2	Laboratory	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	Tests (min.: 2)	1, 2, 3, 4, 5	30	
2	#Assignments (min.: 3)	1, 2, 3, 4, 5	10	
3	Lab Exercises/Reports	1, 2, 3, 4, 5	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
Integrated Photonics: history and motivation.

Theory of Optical Waveguides
Basic analysis of planar waveguides and channel waveguides. Optical waveguide modes. Numerical analysis.

Fabrication and Characterization of Optical Waveguides
Fabrication techniques. Waveguide input and output couplers. Characterization and measurements.

Passive Photonic Waveguide Devices
Coupled mode theory. Passive devices: Directional coupler waveguides; Grating waveguides; Tapered waveguides; Y-junction waveguides; Mach-Zehnder interferometer waveguides; Wavelength-division multiplexing devices.

Active Photonic Waveguide Devices
Physical effects: electro-optic, acousto-optic and magneto-optic effects. Active devices: Waveguide modulators and switches.

Optoelectronic Devices
Semiconductor lasers and detectors. Monolithic integration.

Applications and Trends

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	K. Okamoto, Fundamentals of Optical Waveguides, 2nd Ed., Academic Press, 2006
2	W. S. Chang, Fundamentals of Guided-Wave Optoelectronic Devices, Cambridge University Press, 2010.
3	R. G. Hunsperger, Integrated Optics: Theory and Applications, 5th Edition, Springer-Verlag, Berlin Germany, 2002.