EE6429: OPTICAL FIBRES AND WAVEGUIDES

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Optical Fibres and Waveguides

Subject Code
EE - Electrical Engineering
Course Number
6429

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
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The aim of the course is to provide students with fundamental theoretical knowledge and analytical skills necessary for an in-depth understanding of the modern optical fibre and waveguide technology as well as an opportunity to discover new knowledge in the subject area by carrying out independent research studies on advanced topics of current interest.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain and analyse the modal and transmission characteristics of optical fibres.		x	x	
2	Explain and analyse the modal characteristics of planar waveguides and describe common waveguide fabrication and measurement techniques.		x	x	
3	Explain the physical principles of some common fibre and waveguide devices and analyse their characteristics.		x	x	
4	Perform independent studies on new developments and applications related to the optical fibre and waveguide technology.		x	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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Teaching students important concepts, theories, methodologies, and practices in the subject	1, 2, 3	2 hrs/wk
2	Tutorials	Engaging students in problem solving and discussions to consolidate what they learn in the lectures	1, 2, 3	1hr/wk
3	Take-home/in-class assignments	More challenging problems set as assignments to help students develop the ability/skill to think critically and discover	1, 2, 3	

4	Individual research study on new developments in the subject	Individual studies on topics of current interest to help students develop the ability/skill to learn independently and discover	4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 2, 3	25	
2	Assignments	1, 2, 3	5	
3	Essay on an individually assigned research topic	4	10	
4	Oral presentation on the assigned research topic	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.

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 course provides students with the fundamental theoretical knowledge and analytical skills necessary for an in-depth understanding of the modern optical fibre and waveguide technology, which underlines the advancement of optical communications, optical signal processing, and optical sensing. The students have many opportunities to formulate and solve problems within the subject area by applying the learnt knowledge and skills.

PILO 2, 5 The course provides an opportunity for each student to discover new knowledge by carrying out an independent research study on an advanced topic of current interest.

PILO 6 The students can practise their communication skills through essay writing and power-point presentation of their results on the research studies.

Part III Other Information

Keyword Syllabus

Electromagnetic Theory of Guided Waves
Wave equations
Concept of modes
Optical Fibres
Multimode fibres
Single-mode fibres
Special fibres (birefringent fibres, photonic crystal fibres, multicore fibres, few-mode fibres, etc.)
Transmission characteristics of fibres
Planar Optical Waveguides
Slab waveguides
WKB analysis of graded-index waveguides
Rectangular-core waveguides
Marcatili’ s method
Effective-index method
Fabrication and characterization of waveguides
Coupled-Mode Theory
Coupled-mode equations
Application to parallel waveguides
Application to periodic structures
Selected Topics on Fibre and Waveguide Devices and Applications
Passive devices (couplers, WDM multiplexers, mode multiplexers, gratings, ring resonators, etc.)
Active devices (electro-optic modulators, optical amplifiers, etc.)
Applications (dispersion compensation, advanced multiplexing schemes, optical sensors, optical interconnect, etc.)

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	M J Adams: An introduction to Optical Waveguides (John Wiley, 1981)
2	A W Snyder and J D Love: Optical Waveguide Theory (Chapman and Hall, 1983)
3	T Tamir (Ed.): Integrated Optics (2nd Edition, Springer-Verlag, 1985)
4	H Nishihara, M Haruna, and T Suhara: Optical Integrated Circuits (McGraw-Hill, 1985)
5	D L Lee : Electromagnetic Principles of Integrated Optics (John Wiley, 1986)
6	D Marcuse: Theory of Dielectric Optical Waveguides (2nd Edition, Academic Press, 1991)
7	R Syms and J Cozens: Optical Guided Waves and Devices (McGraw-Hill, 1992)
8	A Ghatak and K Thyagarajan: Introduction to Fiber Optics (Cambridge University Press, 1998)
9	K S Chiang: Integrated Optic Waveguides in Encyclopedia of Electrical and Electronics Engineering J. G. Webster (Ed.) (John Wiley, 1999), Vol. 10, pp. 400-418; updated online version 2007.
10	Websites and articles specified in lectures