EE4035: OPTICAL FIBRE COMMUNICATIONS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Optical Fibre Communications

Subject Code
EE - Electrical Engineering
Course Number
4035

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
and
EE3008 Principles of Communications

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
The aim of the course is to provide students a comprehensive introduction of the optical fibre communication technology.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the physical principles of light propagation in multimode and single-mode optical fibres and analyze their transmission characteristics		x	x	
2	Explain the operation principles of a variety of optical and optoelectronic components commonly used in an optical fibre communication system and analyze the characteristics of these components and their effects on the system performance		x	x	
3	Evaluate and design simple optical fibre communication systems		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	The lecturer delivers the course content and the students are engaged in the discussion of some key concepts. Students solve problems and present their solutions to the class to consolidate their understanding of the course content.	1, 2, 3	3 hrs/wk

2	Laboratory	Students perform experiments to enhance their understanding of some key concepts and learn some technical skills.	1, 2, 3	3 hrs/wk (two weeks)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3	30	
2	#Assignments (min.: 3)	1, 2, 3	12	
3	Lab Exercises/Reports	1, 2, 3	8	

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 coursework 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

Achieving all CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Margin

Failure (F)

Not even reaching marginal

Assessment Task
Coursework

Criterion
Achieving all CILOs

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Margin

Failure (F)
Not even reaching marginal

Part III Other Information

Keyword Syllabus

Overview
History of optical fibre communications. Comparison of various transmission media.

Transmission Characteristics of Optical Fibres
Ray theory applied to multimode fibres. Step-index and graded-index fibres. Wave equation. The concept of guided modes. Dispersion curves. Mode cutoff conditions. Single-mode fibres. Loss mechanisms in fibres. Pulse dispersion in fibres. Dispersion management. Nonlinear effects in fibres. Birefringence in fibres. Special fibres.

Fibre Measurements and Fabrication
Measurements of fibre properties. Fibre materials. Preform fabrication. Fibre drawing. Fibre cabling.

Passive Fibre-Optic Devices
Coupling light into fibre. Joint losses. Fibre splice and connectors. Power dividers. Directional couplers. Wavelength multiplexers/demultiplexers. Optical isolators. Polarization controllers. Fabry-Perot filters. Fibre Bragg gratings. Long-period fibre gratings.

Active Devices and Waveguide Devices
Semiconductor laser amplifiers. Erbium-doped fibre amplifiers. Raman amplifiers. Planar waveguides. Electro-optic waveguide modulators. Arrayed waveguide gratings.

Light Sources and Detectors
Laser diodes. Light emitting diodes (LEDs). PIN diodes. Avalanche photodiodes (APDs).

Optical Fibre Communication Systems
System design considerations. Optical power budgeting. Analog and digital systems. Multiplexing schemes. Examples of applications: trunk networks, undersea transmission systems, local access networks, and local area networks. Emerging technologies.

Laboratory Experiment:
Two three-hour laboratory sessions: Measurement and comparison of LED and laser diode characteristics. Determination of attention in optical fibre links. System bandwidth and fibre dispersion measurements. Eye diagrams and BER in optical fiber communications.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	J M Senior: Optical Fiber Communications, Principles and Practice, (2nd Edition, Prentice Hall, 1992)
2	G P Agrawal: Fiber-Optic Communication Systems, (2nd Edition, John Wiley & Sons, 1997)
3	A Ghatak and K Thyagarajan: Introduction to Fiber Optics, (Cambridge University Press, 1998)
4	G Keiser: Optical Fiber Communications, (3rd Edition, McGraw Hill, 2000)
5	G P Agrawal: Lightwave Technology: Components and Devices, (John Wiley & Sons, 2004)