City University of Hong Kong
Course Syllabus

offered by College/School/Department of Electrical Engineering
with effect from Semester B in 2019/2020

Part I Course Overview

Course Title:	Optical Fibre Communications
Course Code:	EE4035
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	B4
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	EE2104 Introduction to Electromagnetics and EE3008 Principles of Communications
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

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

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain the physical principles of light propagation in multimode and single-mode optical fibres and analyze their transmission characteristics		✓	✓	
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		✓	✓	
3.	Evaluate and design simple optical fibre communication systems		✓	✓	
** If weighting is assigned to CILOs, they should add up to 100%.*		100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3				
Lectures	The lecturer delivers the course content and the students are engaged in the discussion of some key concepts.	✓	✓	✓				2 hrs/wk
Tutorials	Students solve problems and present their solutions to the class to consolidate their understanding of the course content.	✓	✓	✓				1 hr/wk
Labs	Students perform experiments to enhance their understanding of some key concepts and learn some technical skills.	✓	✓	✓				3 hrs/wk (two weeks)

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3					
Continuous Assessment: 50 %								
Tests (min.: 2)	✓	✓	✓				30%	
#Assignments (min.: 3)	✓	✓	✓				12%	
Lab Exercises/Reports	✓	✓	✓				8%	
Examination: 50 % (duration: 2 hrs, if applicable)								
Examination	✓	✓	✓				50%	
** The weightings should add up to 100%.*							100%	

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

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achieving all CILOs	High	Significant	Moderate	Margin	Not even reaching marginal
2. Coursework	Achieving all CILOs	High	Significant	Moderate	Margin	Not even reaching marginal

6. Constructive Alignment with Major Outcomes

Please state how the course contribute to the specific MILO(s)

MILO	How the course contribute to the specific MILO(s)
1, 3, 5	The course requires the analysis and the design of components and systems and therefore provides many opportunities for students to solve engineering problems by applying knowledge of mathematics, science, and engineering.
1, 2, 4, 7, 10	The laboratory element of the course provides an opportunity for students to conduct experiments and analyze and interpret data, and contribute in a team environment. They have the opportunity to use engineering tools in the laboratory sessions. They can also practice their communication skills in report writing and by presentation of their problem solutions and participation in discussion in tutorial sessions.
6	The course provides an opportunity for the students to observe safety rules in using equipment and working in the laboratory.

Part III Other Information (more details can be provided separately in the teaching plan)

1. 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.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Nil

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

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)