COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	7.025	**SEMESTER OF STUDY**	7th
COURSE TITLE	Optical communications		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	3
Tutorial/Project	1	0.5
Laboratory	1	0.5
TOTAL	**5**	**4**

COURSE UNIT TYPE	Scientific area course / specialization / skill development
PREREQUISITES	
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	Yes
WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE124/

(2) LEARNING OUTCOMES

Learning Outcomes

The course is a compulsory elective course (CEC) of the third Direction (Telecommunications and Information Technology) aiming to introduce students the principles of optical communications, by offering them the necessary knowledge and skills to: a) design the implementation of infrastructures, b) to analyze their overall performance as well as that of individual components, c) to supervise and optimize their performance, and d) to study techniques that will allow the development of innovative architectures for the transmission and reception of optical signals. In this context the student will understand the transmission mechanisms in optical waveguides and optical fibers, will be able to calculate the transmission rates supported by the waveguides, will understand in depth the mechanisms of dispersion in optical fibers / waveguides, will gain knowledge of optical source technology semiconductors with emphasis on laser diodes, will acquire the principles of photodiodes and optical receivers, such as noise sources and the fundamental limiting factors, will acquire knowledge of optical modulation systems and the direct signal detection (IM / DD, OOK) and system level performance, error rate (BER), signal-to-noise ratio (SNR), and will understand at an introductory level the building blocks of an optical network.

Upon successful completion of the course the student will be able to:

1. Understand the operation and organization of optical communication systems and the exploitation of applications over them.
2. Knows, recognise and be aware of the tools used for the implementation and management of optical communication systems, as well as the operation of the most widespread mechanisms for services provision.
3. Apply tools for the analysis and the evaluation of the performance of optical communication systems, as well as mechanisms and methods for optimised operation.
4. Analyse and calculate the principle characteristics of information transfer over optical communication systems, their interconnection and to the Internet.
5. Propose solutions for the implementation and maintenance of optical communication systems, and analysis of information that passes over them by utilising international standards.

General Skills

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Decision making
- Autonomous work
- Teamwork
- Work in an international environment
- Work in an interdisciplinary environment
- Promoting liberal, creative and inductive/deductive thinking

(3) SYLLABUS

Theoretical Lectures

- Introduction: Basics of the transmission of video, available standards
- Introduction to optical communication systems
- Optical waveguides and optical fibers: general characteristics, wave theory, guided modes, types of fiber, flat optical waveguides (dielectric plate waveguide).
- Fiber optic transmission: Damping mechanisms, types of dispersion, dispersion of material and waveguide, transmission in single mode fibers. Gaussian pulse transmission in the presence of

GVD & TOD, transmission of arbitrary shape pulses and finite spectral source range, limitations on maximum transmission rate due to dispersion.

- Light sources: basic laser principles, semiconductor emission, Laser diodes (LD), LD types (Fabry-Perot, Edge Emitting, VCSEL), operating characteristics, modulation, Light Emitting Diodes (LEDs), fiber optic coupling.
- Optical detectors: PIN photodiodes and avalanche photodiodes.
- Direct detection optical receiver: noise sources (thermal, quantum, etc), quantum limit, signal to noise ratio (SNR), typical receiver architectures, receiver sensitivity, factors that affect sensitivity.
- Optical communication systems: basic system architectures, design constraints, multiplexing techniques (optical multiplexing with time division OTDM, optical multiplexing with wavelength division WDM).

Laboratory

Projects utilising the exploitation of software tools for simulation and analysis of optical communication characteristics (OptiPerformer), for studying point-to-point connections, the effects of signal degradation/losses, and the dispersion effect over optical fibre.

- Optical link with loss compensation
- Optical link with dispersion compensation
- Optical link using wavelength multiplexing (WDM)

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	• Use of ICTs in lecturing • Use of ICTs in laboratory-based training • Use of ICTs for the communication with students via the e-class platform • Specialised software tools for experimentation • Support of the educational process via the e-class platform
TEACHING ORGANISATION	

Method description / Activity	Semester Workload
Lectures	39
Tutorials	13
Laboratory work	13
Project-based assignments	10
Journal/paper reading & theoretical study	5
Non-guided personal study	40
Total Contact Hours	**120**

ASSESSMENT METHODS	**Language of Assessment** Greek **Description** Written exams, laboratory evaluation and project evaluation

	Student assessment methods • Written examination with short answer questions (Concluding) • Written exams with multiple choice questions (Concluding) • Written assignment (Formative) • Public presentation (Formative) • Laboratory/project work (Formative) For the successful completion of the course the students must obtain a grade of ≥5.0 in both the final written examination and the laboratory work, as well as in the elaboration and public presentation of the project (theoretical study). The final grade of the course consists of: • Final written examination in the entire course content (65%), • Elaboration of theoretical project (10%) • Public presentation of the project (5%), • Elaboration of laboratory-based projects/work (20%). The assessment criteria are announced to students at the beginning of the semester and are published on the course webpage in the e-Class platform.

(5) RECOMMENDED BIBLIOGRAPHY

- Recommended Bibliography:

- *Govind Agrawal P., "Fiber-Optic Communication Systems", WILEY, 4th Edition, ISBN: 978-0-470-50511-3.*
- *Rajiv Ramaswami, Kumar Sivarajan, Galen Sasaki, "Optical Networks: A Practical Perspective", 3rd Edition, 2009, ISBN-13: 978-0123740922.*

- Relevant Scientific Journals:

- *IEEE Communications Magazine*
- *IEEE Journal of Lightwave technology*
- *Elsevier Journal of Optical Switching and Networking*