COURSE OUTLINE

(1) GENERAL INFORMATION

SCHOOL	SCHOOL OF APPLIED MATHEMATICAL AND PHYSICAL SCIENCES		
DEPARTMENT	SCHOOL OF APPLIED MATHEMATICAL AND PHYSICAL SCIENCES		
LEVEL OF STUDIES	POSTGRADUATE		
MSc PROGRAM	MICROSYSTEMS AND NANODEVICES		
COURSE CODE	**9961**	**SEMESTER**	**2**
COURSE TITLE	OPTICAL AND MICRO-OPTICAL DEVICES		

INDEPENDENT TEACHING ACTIVITIES *In cases where credits are awarded to discrete parts of the course (e.g., Lectures, Laboratory Exercises, etc.), specify them. If credits are awarded as a whole, specify weekly teaching hours and total credits.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures – Exercises	12x3	6
Laboratory	3	
Assignments	0	
(Additional rows may be added if necessary. Detailed descriptions of teaching organization and methods are provided in section (d).)		

COURSE TYPE *general background, specialized background, specialization, skill development*	GENERAL BACKGROUND
PREREQUISITES:	[REQUIRED BACKGROUND KNOWLEDGE]: OPTICS
LANGUAGE OF INSTRUCTION and EXAMINATION:	GREEK
COURSE AVAILABLE TO ERASMUS STUDENTS	YES (offered in English as a reading course).
COURSE WEBSITE (URL)	Mycourses.ntua.gr

(2) LEARNING OUTCOMES

Learning Outcomes

This section describes the learning outcomes of the course, specifying the knowledge, skills, and competencies at the appropriate level that students will acquire upon successful completion of the course.

Refer to Appendix A:

- *Description of the Level of Learning Outcomes for each cycle of studies according to the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7, & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B.*
- *Concise Guide to Writing Learning Outcomes*

Knowledge:

The course aims to foster an understanding of the concepts and principles of optics and optoelectronics in micro-optical systems, introducing students to:

- the concepts, development techniques, and operation of optical arrangements and integrated optical systems,
- the advantages of micro-optical devices compared to micro-electronic systems,
- the technologies involved in developing optical micro-components.

  Additionally, the course covers the operating principles of optical elements and phenomena underlying micro-optoelectronic systems, helping students understand the fundamental and critical points of the subject.

Skills:

Upon successful completion of the course, students will be able to:

- Understand the operational environment and applications of optical devices, components, and detectors.
- Design and select the characteristics of optical components for a given optoelectronic application.
- Be familiar with the methods and micro-engineering technology for developing and manufacturing optical micro-components.
- Identify and apply optical design principles to enhance the performance of micro-optical systems.
- Analyze and interpret optical phenomena critical to the functionality of micro-optoelectronic systems.
- Evaluate the performance and limitations of different optical materials and devices in micro-optical applications.
- Employ computational tools to simulate optical systems and predict their behavior in various applications.
- Integrate knowledge of optics and micro-engineering to troubleshoot and optimize micro-optical components in practical scenarios.
- Apply principles of photonics and optoelectronics to the design and development of advanced optical devices and systems.

General Competencies

Considering the general competencies that graduates are expected to acquire (as stated in the Diploma Supplement), which competencies does this course aim to develop?.

Data search, analysis, and synthesis, utilizing necessary technologies *Adaptability to new situations* *Decision-making* *Independent work (primarily through assignments completed at home)* *Teamwork* *Working in an international environment* *Working in an interdisciplinary environment*	*Generation of new research ideas* *Project design and management* *Respect for diversity and multiculturalism* *Respect for the natural environment* *Exhibiting social, professional, and ethical responsibility and sensitivity to gender issues* *Critical and self-critical thinking* *Promotion of free, creative, and inductive thinking*

Competencies:

Successful completion of the course cultivates the ability to:

- Understand applications through both theoretical knowledge and hands-on laboratory exercises.
- Select appropriate physical parameters/variables that define a physical/scientific/technological problem.
- Search for, analyze, and synthesize data and information (using the necessary technologies) and adapt them to specific technological challenges with reasonable and necessary approximations.
- Adapt to new situations and make informed decisions.
- Work independently and collaboratively.
- Operate effectively in an interdisciplinary environment.
- Generate new research ideas.

(3) COURSE CONTENT

Principles of Electromagnetic (EM) Optics, Propagation in dielectric media, Fresnel equations, planar waveguide, cutoff frequency, dispersion, cylindrical waveguide.

Laser diodes (Distributed Feedback, Distributed Bragg Reflector, Vertical Cavity Surface Emitting Light), Erbium Doped Fiber Amplifier, Light Emitting Diodes). Growth methods of integrated optics and MOEMS. Switches and light modulators. Fabry-Perot and Mach-Zender interferometers. Pockel and Kerr effects. Principles of operations of micro-electro-mechanical systems (elements of transmission, reflection, diffraction and interference of light. Applications (examples of telecommunication systems, WDM, multiplexing, pressure sensors, etc.)

(4) TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *In person, Distance Learning etc.*	In person
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) *Use of Information and Communication Technologies (ICT) in Lecturing, Laboratory Training, Communication with Students*	Lecture slides, notes, and homework assignments (assigned by the lecturer and submitted by students). Use of ICT in communication with students via the myCourses platform.
ORGANIZATION OF TEACHING *A detailed description of the teaching methods and approaches used in the course, which may include:* *Lectures, Seminars, Laboratory Exercises, Fieldwork, Study and Analysis of Bibliography, Tutorials, Internships, Clinical Exercises, Art Workshops, Interactive Teaching, Educational Visits, Project Development, Report Writing/Assignments, Artistic Creation.* *The student's study hours for each learning activity, as well as hours of independent study, are outlined in accordance with ECTS principles.*	see table below

Activity	***Semester Workload***
Lectures	10x3=30 hours
Study	10x3=30 hours
Home Assignments/Exercises	
Laboratory	4 hours
Completion/Presentation of Project	3 hours
Educational Visits	
Examinations	
Total Course Load	67

STUDENT ASSESSMENT *Description of the Assessment Process* *Language of Assessment, Assessment Methods, Formative / Summative Assessment Methods, Multiple-choice tests, Short-answer questions, Essay-style questions, Problem-solving exercises, Written assignments, Reports, Oral examinations, Public presentations, Laboratory work, Clinical patient examinations, Artistic interpretations, Other methods, as appropriate* *The assessment criteria are clearly defined and provided to students, ensuring transparency in the evaluation process. These criteria are accessible through the course's online platform where students can review them at any time.*	Language of Assessment: Greek (for Erasmus students: English) **Written Examination (problem-solving): 30% of the final grade** **Project Completion/Presentation: 70% of the final grade**

(5) RECOMMENDED BIBLIOGRAPHY

Recommended Bibliography

1) ***Born, M., & Wolf, E. (1998). Principles of Optics. Cambridge University Press.***
2) ***Hecht, E. (2003). Optics. Addison Wesley.***
3) ***Senior, J. (1997). Optical Fiber Communication. Prentice Hall.***
4) ***Battacharya, P. (1997). Semiconductor Optoelectronic Devices. Prentice Hall.***

5) *Lee, D. (1986). Electromagnetic Principles of Integrated Optics. John Wiley & Sons.*
6) *Waiser, R. (2003). Nanoelectronics and Information Technology. Wiley-VCH.*
7) *Kasap, S.O. (2001). Optoelectronics and Photonics. Prentice Hall.*
8) *Selected review articles on MOEMS and Integrated Optics.*
9) *I. Zergioti, lecture notes for "Micro-optical Devices and Integrated Optics".*