Işık University
Faculty of Arts and Sciences
Department of Physics

PHYS 485 - Photonics

COURSE SYLLABUS

Course Name	Code	Semester	Theory (hour/week)	Application (hour/week)	Laboratory (hour/week)	Local Credits	ECTS
Photonics	PHYS 485	Fall	**3**	0	**0**	**3**	5

Prerequisities	None

Course Language	English
Course Type	Required
Course Level	First Cycle
Course Coordinator	-
Course Lecturer(s)	-
Course Assistants	-
Course Objectives	Photonics is a one semester course that introduces the fundamental concepts of photonics. By the end of the course, students should • demonstrate a knowledge of the fundamental concepts of photonics. • recognize the basic principles involving propagation of light in vacuum and matter. • develop an understanding of how light interacts with matter. • recognize how physics is relevant to the world around them.
Course Learning Outcomes	On successful completion of this course students will be able to 1. demonstrate a knowledge of the nature and propagation of light in vacuum and matter. 2. devise waveguiding of light and fiber-optics. 3. outline the basics of semiconductor physics. 4. describe how light can be produced and its properties can be determined. 5. discuss the operating principles of lasers. 6. develop an insight into optical communication systems and their operating principles. 7. perform simple measurements in optics. 8. show an increased competence to effectively communicate an accomplished project in both written and verbal form.
Course Content	Maxwell's equations and light propagation. Interference, temporal and spatial coherence. Diffraction and diffraction gratings. Dielectric waveguides and optical fibers; dispersion in optical fibers. Polarization, interaction of light and matter. Light propagation in crystals; birefringence, optical activity. Electro-optic effects: Pockels and Kerr effects with electro-optic devices based on the Pockels and Kerr cells. Acousto-optic modulators and magneto-optic effect. Nonlinear optics and 2nd Harmonic Generation. Semiconductor fundamentals. Stimulated emission, gas lasers, semiconductor lasers, and laser amplifiers. Quantum wells, quantum dots, VCSELs, and holography. Semiconductor photon detectors

WEEKLY SUBJECTS AND RELATED PREPARATION STUDIES

Week	Subject
1	Maxwell's equations, wave equation in free space and matter
2	Plane waves in matter, attenuation, boundary conditions Review of optics: Snell's law, reflection, refraction
3	Fresnel equations, diffraction, interference Planar waveguides: waveguide modes, mode velocities, mode patterns
4	Planar waveguides: Dispersion. Cylindrical waveguides: acceptance angle, numerical aperture, waveguide modes, mode patterns, single and multimode fibers
5	Losses in optical fibers: absorption, scattering, and bending losses
6	Optical fibers: mode coupling, cladding modes, step and graded index fibers.
7	Dispersion in optical fibers: intermodal and intramodal dispersion, Fiber connections and diagnostics
8	Semicondostor physics: energy bands, valance band, conduction band, bandgap, emission and absorption processes
9	Review
10	Semiconductor physics: reduced zone scheme, direct and indirect gap materials, photodetectors, light emitters, radiative efficiency
11	Layered semiconductors: n-type, p-type semiconductors, p-n junctions, heterojunctions, metal-semiconductor junctions
12	Light sources: LED, laser diode
13	Optical detectors: thermal detectors, photon detectors
14	Photodiode detectors
15	Lasers and coherent light

TEXTBOOKS

Required Textbook(s)	Richard S. Quimby, *Photonics and Lasers, an Introduction*, Wiley, 2006.
Recommended Readings	Bahaa E. A. Saleh, Malvin Carl Teich, *Fundamentals of Photonics, 2nd Edition*, Wiley, 2007.

EVALUATION SYSTEM

Semester Requirements	**Number**	**Percentage of Grade**
Attendance/Participation	-	-
Laboratory	-	-
Application	-	-
Field Work	-	-
Special Course Internship (Work Placement)	-	-
Quizzes/Studio Critics	4	10
Homework Assignments	10	15
Presentation/Jury	1	25
Project	-	-
Seminar/Workshop	-	-
Midterms/Oral Exams	2	50
Final/Oral Exam	-	-
Total	18	100

Percentage of Semester Work	17	75
Percentage of Final Work	1	25
Total	18	100

COURSE CATEGORY

ISCED GENERAL FIELD CODE	GENERAL FIELDS	ISCED MAIN AREA CODE	MAIN EDUCATIONAL AREAS	%
1	Eğitim	14	Öğretmen Yetiştirme ve Eğitim Bilimleri	0
2	Beşeri Bilimler ve Sanat	21	Sanat	0
2	Beşeri Bilimler ve Sanat	22	Beşeri Bilimler	0
3	Sosyal Bilimler, İşletme ve Hukuk	31	Sosyal ve Davranış Bilimleri	0
3	Sosyal Bilimler, İşletme ve Hukuk	32	Gazetecilik ve Enformasyon	0
3	Sosyal Bilimler, İşletme ve Hukuk	38	Hukuk	0
4	Bilim	42	Yaşam Bilimleri	0
4	**Bilim**	**44**	**Doğa Bilimleri**	**70**
4	**Bilim**	**46**	**Matematik ve İstatistik**	**5**
4	Bilim	48	Bilgisayar	0
5	**Mühendislik, Üretim ve İnşaat**	**52**	**Mühendislik**	**25**
5	Mühendislik, Üretim ve İnşaat	54	Üretim ve İşleme	0
5	Mühendislik, Üretim ve İnşaat	58	Mimarlık ve Yapı	0
6	Tarım	62	Tarım, Ormancılık, Hayvancılık ve Su Ürünleri	0
6	Tarım	64	Veterinerlik	0
7	Sağlık ve Refah	72	Sağlık	0
7	Sağlık ve Refah	76	Sosyal Hizmetler	0
8	Hizmet	81	Kişisel Hizmetler	0
8	Hizmet	84	Ulaştırma Hizmetleri	0
8	Hizmet	85	Çevre Koruma	0
8	Hizmet	86	Güvenlik Hizmetleri	0

THE RELATIONSHIP BETWEEN COURSE LEARNING OUTCOMES AND PROGRAM OUTCOMES

Number	Program Outcomes	Level of Contribution*				
		1	2	3	4	5
1	To have a comprehension of the core areas of physics, including classical and quantum mechanics, electromagnetism, statistical and thermal physics.					X
2	To have a comprehension of basic mathematics, including differential and integral calculus, linear algebra, differential equations and complex analysis.				X	
3	To have a comprehension of computer programming and chemistry.					
4	To have a comprehension of the importance and practice of good ethical standards.				X	
5	To have a recognition of contemporary issues in science and its applications.					X
6	To have an ability to construct theoretical models, solve problems, design and conduct experiments, as well as to analyze and interpret data.					X
7	To have an ability to demonstrate their understanding of at least one advanced topic in theoretical or experimental physics.					X
8	To have an ability to function on multi-disciplinary teams					
9	To have an ability to effectively communicate information in both written and verbal form					X
10	To have a recognition of the need for and an ability to engage in life-long learning.				X	
11	To have an ability to use modern physics techniques, skills, and computing tools necessary for physics practice (use laboratory and workshop equipment to generate data, prepare technical drawings, prepare technical reports, give technical presentations, take notes effectively, write computer programs, use mathematics and/or computational tools and packages to make models) .					X

*1 Lowest, 2 Low, 3 Average, 4 High, 5 Highest

Contribution of Course Learning Outcomes to Program Outcomes	The class contributes to the student development in terms of providing the fundamentals of photonics and the physical concepts behind them. Students should develop problem solving abilities and enhance critical thinking and improve their written communication skills.

ECTS / WORKLOAD TABLE

Activities	**Number**	**Duration (Hour)**	**Workload (Hour)**
Course Hours (Including Exam Week: 16 x Total Hours)	15	3	45
Laboratory	-	-	-
Application	-	-	-
Special Course Internship (Work Placement)	-	-	-
Field Work	-	-	-
Study Hours Out of Class	15	1.6	24
Presentations / Seminar	1	14	14
Project	-	-	-
Homework Assignments	10	2	20
Quizzes	4	1	4
Midterms / Oral Exams	2	9	18
Final / Oral Exam	-	-	-
		Total Workload	**125**
		Total Workload/25	**5**