



Lahore University of Management Sciences

PHY 518 / EE 538 – Photonics Fundamentals

Spring 2022

Instructor	Tayyab Imran
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Office Hours	
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Course URL (if any)	

Course Teaching Methodology
<ul style="list-style-type: none">Physical

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 minutes
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution	
Core	No
Elective	Yes
Open for Student Category	Juniors, Seniors, MS, PhD
Close for Student Category	Freshman, Sophomore

COURSE DESCRIPTION
<p>Photonics is a branch of physics and engineering which deals with the generation, propagation, manipulation, control, and detection of light [in free space or a matter] within the 'optical' region of the electromagnetic spectrum. This course provides a comprehensive introduction into this important field, from Maxwell's equations to the level of photonic components and building blocks such as lasers, amplifiers, modulators, waveguides, and detectors.</p> <p>This course is divided into two parts: Fundamentals and applications. The fundamentals include Maxwell's equations and wave propagation. The applications include nonlinear optics, electro-optics, and acousto-optics.</p>

COURSE PREREQUISITE(S)
<ul style="list-style-type: none">An undergraduate course in electromagnetic theory is required.

COURSE OBJECTIVES
<ul style="list-style-type: none">The course is aiming at giving a basic and technological understanding of photonics and photonic components, their working, and functioning.



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Learning Outcomes (CLO)	
	<ol style="list-style-type: none"> 1. Interpretation and understanding of Maxwell equations and electromagnetic waves in photonics 2. Study of waveguides, and Fiber optics. 3. Concepts of laser and laser-matter interaction. 4. Photon detections, photodiodes 5. Study of acousto-optics, electro-optics, Nonlinear optics, and ultrafast optics 7. Overview: An experimental understanding, measurement in photonics and photonic device characterization

Grading Breakup and Policy		
Component	Weightage	Description
Assignments	20%	<ul style="list-style-type: none"> • 4 Homework/Assignments
Midterm	20%	<ul style="list-style-type: none"> • Physical Examination
Project/laboratory	20%	<ul style="list-style-type: none"> • Physical Examination
Final exam	40%	<ul style="list-style-type: none"> • Physical Examination

- The instructor reserves the right to vary these grade assignments or add new instruments by upto 10%.
- After the submission of a HW/Midterm/Final (within a week of it), I may randomly select student(s) for an interview (10-15 minutes) and ask them questions related to their submission. The grade assigned in the HW/Mid/Final will depend on adequately answering these questions, and not on the written submission alone.
- University policy for cheating/unfair means will be applicable on all grading instruments.
- Any disability, sickness, or chronic internet issues should be brought to the instructor immediately, as soon as possible. Also, help can be sought from the office of student affairs (OSA) and office accessibility and inclusion (OAI). We will follow the policy of university and decisions made by the OSA accordingly.
- In case the university decides to open the campus, and we transition to on-campus learning, the midterm and/or the final exams may be converted to 3 hour duration closed book/closed notes exams.

Examination Detail	
Midterm Exam	Yes/No: Yes Combine Separate: Duration: Preferred Date: Exam Specifications: Physical
Final Exam	Yes/No: Yes Combine Separate: Duration: Exam Specifications:

COURSE OVERVIEW			
Lecture	Tentative list of topics	Recommended Readings	Objectives/ Application
1-2	Maxwell's equations, wave equation, Boundary conditions, monochromatic electromagnetic waves	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich Optical Waves in Crystals, by Amnon Yariv and Poochi Yeh	CLO 1



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3-4	Polarization of light, Reflection, and refraction, Optics of anisotropic media	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich	CLO 1
5-6	Optical activity and magneto-optics, optics of liquid crystals, polarization devices	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich	CLO 1
7-8	Planar-mirror waveguide, Planar dielectric waveguide, two-dimensional waveguide, optical coupling in waveguide	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich	CLO 2
9-10	Fiber optics, Guided rays, Guided waves, attenuation, and dispersion, photonic-crystal fibers	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich Photonics Essentials; An Introduction with Experiments, by Thomas P. Pearsall	CLO 2
11-12	Interaction of photons with atoms, thermal light, and luminescence	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich	CLO 3
13-15	Lasers, theory of laser oscillations, characteristics of the laser output, types of lasers, pulsed lasers	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich Photonics Essentials; An Introduction with Experiments, by Thomas P. Pearsall	CLO 3
16-17	Photodetectors, photoconductors, photodiodes, Avalanche photodiodes, Noise in photodetectors	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich Photonics Essentials; An Introduction with Experiments, by Thomas P. Pearsall	CLO 4
18-20	Acousto-optics, Interaction of light and sound, Acousto-optics devices, Acousto-optics of anisotropic media	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich Optical Waves in Crystals, by Amnon Yariv and Poochi Yeh	CLO 5
21-22	Principle of electro-optics, Electrooptics of anisotropic media, Photorefractivity	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich Optical Waves in Crystals, by Amnon Yariv and Poochi Yeh	CLO 5
23-24	Nonlinear optics, Second and third-order nonlinear optics	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich	CLO 5
25-26	Ultrafast optics, Pulse characteristics, pulse propagation in Optical fibers, Pulse detection	Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich	CLO 5
27-28	Measurement in Photonics, Experimental photonics, Photonic device characterization in the laboratory	Photonics Essentials; An Introduction with Experiments, by Thomas P. Pearsall	CLO 6

Textbook(s)/Supplementary Readings

1. Fundamentals of Photonics, by B. E. A. Saleh, and M. C. Teich [2019, Third Edition]
2. Optical Waves in Crystals, by Amnon Yariv and Poochi Yeh [1984, First Edition]
3. Photonics Essentials; An Introduction with Experiments, by Thomas P. Pearsall [2003, First Edition]



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Academic Honesty

The principles of truth and honesty are recognized as fundamental to a community of teachers and students. This means that all academic work will be done by the student to whom it is assigned without unauthorized aid of any kind. Plagiarism, cheating and other forms of academic dishonesty are prohibited. Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving a failing grade on the assignment in question or in the course overall. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.

Harassment Policy

SSE, LUMS and particularly this class, is a harassment free zone. There is absolutely zero tolerance for any behaviour that is intended, or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.

In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any queries, clarifications, or advice.

You may choose to file an informal or a formal complaint to put an end of offending behavior. You can find more details regarding the LUMS sexual harassment policy [here](#).

To file a complaint, please write to harassment@lums.edu.pk.

SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Rights and Code of Conduct for Online Teaching

A misuse of online modes of communication is unacceptable. TAs and Faculty will seek consent before the recording of live online lectures or tutorials. Please ensure if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, lms) over informal means to communicate with course staff.