Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites
		Theo.	Lab.	Credit	ECTS			
Quantum Optics	PHYS621	3	-	3	9	1st/ 2nd	2nd/ 3rd	-

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	Preparation for classes	120
Laboratory	-	Case studies	-
Exams and quizzes	5	Working on lab experiment	-
Lab demo	-	HW/Assignments	40
		Study for exam	36
Total	50	Total	196
Total Learning Hours = 246		Equivalent ECTS points = Total LH/28 = 9	

BRIEF COURSE DESCRIPTION

- This course is designed to provide the semiclassical description of EM field as well as its quantum mechanical quantization. It treats the optical cavity, optical coherence, interferometry and photo detection using quantum mechanical operators. It also considers atom-field interaction, Jaynes-Cummings model, analyses of open quantum mechanical systems as well as discrete system.

COURSE OBJECTIVES

The main objectives of this course are focused on the following:

1. Analyze some semiclassical descriptions as well as quantization of EM.
2. Discuss the basics of mixed and pure optical quantum states and their calculation.
3. Formulate mathematical derivation of quantum states and their representations as well as their measurements.
4. Analyze the atom-light interaction using semi-classical and quantum mechanical approaches.
5. Describe various quantum systems, optical processes and quantum electrodynamics.
6. Solve problems related to quantum state and quantum electrodynamics.

COURSE CONTENTS

- Field quantization
- Coherent states
- Atom-field interactions
- Quantum coherence functions
- Beam splitters and interferometers
- Nonclassical light
- Dissipative interactions and decoherence.
- Optical test of quantum mechanics
- Experiments with trapped ions and atoms

ASSESSMENT CRITERIA

- Mid-Term exam and Quizzes: 30 %
- Assignments and classroom activities: 20 %
- Final Exam: 50%

COURSE TEACHING STRATEGIES

- Lectures, Problem Based Teaching, Interactive Discussions, tutorials, Expository and Discovery, and Interactive Discussions.

TEXT BOOK

- C. C. Gerry and P.L. Knight, Introductory Quantum Optics, 2nd ed. Cambridge University Press; 2023

REFERENCE BOOKS

- M. O. Scully and M. S. Zubairy, Quantum Optics, (Cambridge University Press, 1997).
- R. Loudon, The Quantum Theory of Light, 3rd edition, (Oxford Science Publications,2000).
- G. Grynberg, A. Aspect, C. Fabre, Introduction to Quantum Optics, (Cambridge Univ. Press, 2010).
- Z. Ficek and S. Swain, Quantum Interference and Coherence, Theory and Experiments, (Springer, New York, 2005)
- P. Rice, an introduction to Quantum Optics, IOP Publishing Ltd, 2020.