Course Specification
(Bachelor)

Course Title:	**Fundamentals of Photonics**
Course Code:	**PHY 1440**
Program:	**Bachelor of Science in Physics.**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	1
Last Revision Date:	***26/09/2024***

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 7 or 8/ Year 4)					
4. Course General Description:					
This course provides the essential background in photonics necessary to understand modern photonic and optoelectronic phenomena and devices based on classical and quantum properties of radiation. It covers Electromagnetic optics, polarization and crystal optics, guided-wave optics, fiber optics, photons in semiconductors, semiconductors in photon sources and detectors, nonlinear optics, electro-optics, and acousto-optics, quantum theory of light, matter and its interaction, classical and quantum noise, lasers and laser dynamics, and semiconductor optoelectronics and nonlinear optics.					
5. Pre-requirements for this course (if any)**:**					
Electronics, PHY 1324					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Introduce students to basic principles and fundamentals of photonics.**
- **Understand the knowledge of semiconductor lasers and provides a general knowledge of optical devices employing electro-optic, acousto-optic, and nonlinear effects.**
- **Present a solution to a physics problem in a clear and logical written form.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Recognize the scientific method of inquiry to conclude the concepts of photons optics and atoms.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe the scientific method of inquiry to conclude the concepts of laser and laser amplifiers.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Describe the scientific method of inquiry to conclude the concepts**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	photonic in semiconductors.			
1.4	**Describe the scientific method of inquiry to conclude the concepts of electro-optics, nonlinear optics and acousto-optics.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying waves and optical physics.**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	▪ Problem classes and group tutorial. ▪ Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner orally, and using IT for acquiring and analyzing information.**	**S4, S5**	• Lectures. • Class discussions. • Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Exams. ▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. • Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**Photons Optics and Atoms:** Photon, Photon streams, Quantum states of light, Atoms, Molecules, Solids, Interaction of Photons with atoms, thermal light, Luminescence light.	**12**

2.	**Laser Amplifiers and Laser:** Laser amplifier, Amplifier power source, Amplifier nonlinear, Amplifier Noise, Theory of laser oscillation, Pulsed Laser.	**8**
3.	**Photonic in Semiconductors:** Semiconductors, Interactions of photons with electrons and holes, Light-emitting diodes, Semiconductors laser amplifier, Semiconductor injection lasers, Properties of semiconductors photo-detectors, Photon-conductors, Photon-diodes, Noise in photon-detectors.	**12**
4.	**Electro-Optics:** Principles of electro-optics, Electro-optics of anisotropic media, Electro-optics of Liquid crystals, Photorefractive materials.	**8**
5.	**Nonlinear Optics:** Nonlinear optical media, Second-order nonlinear optics, Third-order nonlinear optics, Coupled-wave theory of three-wave mixing, Coupled-wave theory of four-wave mixing, Anisotropic nonlinear media, Dispersive nonlinear, Optical solitons.	**12**
6.	**Acousto-Optics:** Interaction of Light and Sound, Acousto-optic devices, Acousto-optics of anisotropic media.	**8**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (class quizzes, homework, solving problems, etc.....)**	**weekly**	**10 %**
2.	**Midterm Exam 1**	**6th week**	**25 %**
3.	**Midterm Exam 2**	**12th week**	**25 %**
4.	**Final Exam**	**16th week**	**40 %**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Bahaa E. A.S. and Malvin C.T., ***Fundamentals of Photonics,*** 2nd Edition, Wiley (2007).
Supportive References	
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- Classrooms. - Labs.
Technology equipment (projector, smart board, software)	- Classroom equipped with a whiteboard and a projector.
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students Second examiner	Indirect (The students complete the evaluation forms at the end of term. Final exam is evaluated by the second examiner)
Effectiveness of Students assessment	Instructors	Direct (exams, HW, project, …)
Quality of learning resources	Faculty Students	indirect (surveys)
The extent to which CLOs have been achieved	Instructors Program Leaders	Direct (excel sheet)
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Quality Unit-Physics Department
REFERENCE NO.	Department council No. 06
DATE	26/09/2024