هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title	**Laser Physics**
Course Code:	**PHY 1445**
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/ Year4)					
4. Course General Description:					
This course provides a clear, up-to-date, and comprehensive introduction to the physical and principles of laser operation and design. Simple explanations, based throughout on key underlying concepts, lead from the basics of laser action to advanced topics in laser physics. The course is aimed to give students practical skills and certain degree of confidence for working with lasers and/or using laser-based equipment in future.					
5. Pre-requirements for this course (if any)**:**					
Atomic physics, PHY 1362					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Understand the fundamental of laser physics and provide an overview of the physics of modern optical technology.**
- **Full knowledge of the description to describe the interaction of light with matter.**
- **To understand some applications of lasers and the associated physics.**
- **Deep understanding about laser device design and its performance.**
- **Laser applications in different disciplines such as of military, medical and industrial.**

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 concepts of ordinary Light and Lasers.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe the scientific method of inquiry to conclude concepts of the Laser Action.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Describe the scientific method of inquiry to conclude concepts of laser Oscillator.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.4	**Describe the scientific method of inquiry to conclude concepts of**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	properties of laser radiations.			▪ Homework.
1.5	**Describe the scientific method of inquiry to conclude concepts of Laser System.**	**K1, K2**	• Lectures. • Class discussions. Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying laser 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.	**Ordinary Light and Lasers:** Nature of the Light, Brief history of Lasers, Interaction of radiation with matter, Energy levels, Population density, Boltzmann distribution, Transition life-times, Allowed and forbidden transitions, Stimulated absorption, Spontaneous emission and stimulated emission, Einstein's coefficients, Einstein's relations.	**12**

2.	**Laser Action:** Condition for large stimulated emission, Population inversion, Condition for light amplification, Gain co-efficient, Threshold gain coefficient, Line shape function, Active medium, Metastable states, Pumping schemes: three level and four level.	**12**
3.	**Laser Oscillator:** Optical feedback, Round trip gain, Threshold gain, Critical population inversion, Optical resonator, Condition for steady state oscillations, Cavity resonance frequencies.	**12**
4.	**Properties of Laser Radiations:** Laser Line-width, Laser frequency stabilization, Beam Divergence, Beam coherence, Brightness, Focusing properties of laser radiation, Laser modes, Doppler broadening, Broadening small signal gain, 3 level laser and 4 level rate equations Q-switching.	**12**
5.	**Laser System:** Active medium. Excitation mechanism feedback mechanism. Atom Gas: Helium-Neon laser (He-Ne). Ion gas, Argon ion laser (Ar+). Molecular Gas: Carbon dioxide laser (CO2). Nitrogen laser (N2). Solid state lasers: Ruby laser. Neodymium YAG and Nd glass laser. Diode laser: (semiconductor laser, injection laser) - Liquid Laser: Dye laser.	**12**
6.	**Ordinary Light and Lasers:** Nature of the Light, Brief history of Lasers, Interaction of radiation with matter, Energy levels, Population density, Boltzmann distribution, Transition life-times, Allowed and forbidden transitions, Stimulated absorption, Spontaneous emission and stimulated emission, Einstein's coefficients, Einstein's relations.	**12**
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**	**16thweek**	**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	- Silfvast W.T., ***Laser Principles,*** 2nd Edition, Cambridge, ISBN 0-521-83345-0, (2004).
Supportive References	- Masilamani V. and Azzeer A.M., ***Laser: The Light Extraordinary,*** Anuradha Agencies (1999).

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**