



Course Specification

(Bachelor)

Course Title: Laser Physics

Course Code: PHYS 0445

Program: BSc in Physics

Department: Physics

College: College of Science

Institution: Majmaah University

Version: 2

Last Revision Date: 30/12/2024



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A. General information about the course:

1. Course Identification

1. Credit hours: (3,0,0)

2. Course type

A. University College Department Track Others
B. Required Elective

3. Level/year at which this course is offered: (Fifth level)

4. Course General Description:

The aim of the course is to describe the principles of lasers and laser action. The course covers interactions of atoms and molecules with light (absorption, emission and dispersion) and includes concepts such as Doppler, collision, and natural lifetime broadening, optical saturation, population inversion, and optical pumping. The principles of laser resonators and laser action (gain, threshold, power, frequency) are discussed. The properties of Gaussian beam propagation are introduced. The course will discuss some common types of lasers in more detail, including continuous-wave (cw) and pulsed, gas, dye, and solid-state lasers.

5. Pre-requirements for this course (if any):

Atomic and Molecular Physics PHYS 0443

6. Co-requisites for this course (if any):

NA

7. Course Main Objective(s):

Aim of this module is to give fundamental understanding of Laser Physics by covering the following details

- Absorption and Emission of light, Einstein Relations, Population inversion, Gain coefficient,
- Optical resonator, Laser Modes,
- Solid state lasers, semiconductor lasers, Gas lasers, Dye lasers, Free electron laser and some new lasers.
- Laser beam properties, Line width, Divergence, coherence, Brightness, Focusing properties of laser,
- Q- switching, Frequency doubling, Phase conjugation.
- Applications: medical, industrial, Military, Scientific, Holography and compunctions.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100
2	E-learning		
3	Hybrid		



No	Mode of Instruction	Contact Hours	Percentage
	<ul style="list-style-type: none"> Traditional classroom E-learning 		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
Total		45

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			
1.2	Recognize optical components that can be used to tailor the properties of the laser	K2	<ul style="list-style-type: none"> - Developing basic communicative - Ability through short and varied situated discourse. - Lecturing - Team work Exercises 	<ul style="list-style-type: none"> • Homework. • Group Discussion • Presentation • Mid-term exam 1 • Mid-term exam 2 Final Exam
2.0	Skills			
2.2	Solve various examples regarding concepts and	S2		





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	principals of laser physics and classical model of spontaneous emission and absorption			
2.3	Explain what the resonator stability condition and the relationship between the optical cavity modes and oscillating laser mode is	S3		
3.0	Values, autonomy, and responsibility			
13.2	Present a short report in a written form and orally using appropriate scientific language	Learn how to collect and classify the required topics using internet communication tools.	Give time bound task.	Observation Group discussion

C. Course Content

No	List of Topics	Contact Hours
1.	Light as electromagnetic field and photons Structure of matter: atoms, molecules and solids Introduction to laser operation	3
2.	Classical model of spontaneous emission and absorption Absorption of broadband light Stimulated emission Collision and Doppler broadening Voigt profile, Absorption and gain coefficients	6
3.	Laser threshold Photon and population rate equations Laser output power Three and four level system Saturation	6
4.	Gaussian beams Resonator stability Gaussian resonator modes	6





5.	Laser oscillation Obtaining single-mode oscillation Frequency stabilization Multimode and pulsed lasing Methods of mode locking	6
6.	Gas, dye and solid-state lasers Pumping mechanisms, He-Ne and other gas lasers	6
7.	Laser applications Lasers in medicine Laser absorption spectroscopy Diode lasers and optical communications	6
8.	Problem solving session Summary of the course	6
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6	15 %
2.	Midterm 2	11	15 %
3.	Electronic Exam	13	10 %
4.	Quiz	10	10 %
5.	HW	Every week	10 %
6.	Final Exam	End of the semester	40 %
7.	Total		100 %

*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	Laser Physics, Simon Hooker and Colin Webb, (2010) ISBN-10: 0198506929
Supportive References	Lasers: principles and applications, J. Willson and J. F. B. Hawkes, (1987) ISBN: 013523705X <i>Lasers: Fundamentals and Applications</i> • K. Thyagarajan, Springer; 2nd ed. 2011 edition (October 5, 2010)
Electronic Materials	http://www.colorado.edu/physics/2000/index.pl



Other Learning Materials

Principles of Laser Materials Processing, Elijah Kannatey-Asibu Jr, (2009) ISBN: 0470177985

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Furnished Lecture Room equipped with smart board and computer.
Technology equipment (projector, smart board, software)	Computational Lab with proper software.
Other equipment (depending on the nature of the specialty)	Library, Seminar Room, and Wi-Fi internet connections.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Subject Teacher	Statistical Analysis
Effectiveness of Students' assessment	Quality Director	Survey
Quality of learning resources	Subject Teacher	Meetings with Students
The extent to which CLOs have been achieved	Program Leaders	Survey
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	DEPARTMENT COUNCIL
REFERENCE NO.	16
DATE	30/12/2024

