هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Laser Physics and its Applications**
Course Code:	**2034203-4**
Program:	**Bachelor in Physics**
Department:	**Physics Department**
College:	**College of Science**
Institution:	**Taif University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)

2. Course type

A.	☐University	☐College	☒ Department	☐Track	Others
B.	☒ Required		☐Elective		

3. Level/year at which this course is offered: (8th Level / 4th Year)

4. Course general Description:

The chief purpose is for students to obtain a solid understanding of the basic principles of lasers and to be familiar with the operation of most common laser types. It reviews the basic physics of optical cavities and the spontaneous/stimulated emission from materials leading to laser amplifiers and oscillators. Properties of laser cavities the optics of Gaussian beam and laser applications are discussed.

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

Modern physics 2033105-4

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

Physical Optics 2033104-4

7. Course Main Objective(s):

The aim of the course is that the student at the end of the course shall:

- **have acquired a thorough understanding of the theory of modern laser physics,**
- **be able to describe in detail the inherent behavior and functionality of the many different types of modern lasers,**
- **have acquired a deep understanding of the detailed properties of coherent laser light,**
- **be able to formulate reasonably complicated problems in laser physics and provide solutions to the same**
- **understand in depth the optical resonance.**
- **be able to differentiate between types of lasers.**
- **develop knowledge of applications of laser.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning		
3	Hybrid		

No	Mode of Instruction	Contact Hours	Percentage
	• 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**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

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

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Describe laser operation and gain saturation.	K3	Group discussion	Quizzes
1.2	Recognize the physics governing laser behaviour and light matter interaction experimentally.	K3	Lecture and Group discussion	Written exam
1.3	Summarize information in different types of laser technology.	K3	Lecture Discussion	Written exam
2.0	**Skills**			
2.1	Apply the principles of atomic physics to materials used in lasers and optics.	S1	Lectures	Written exam and Homework reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	Develop problem solving skills in laser physics	S2	Lecture and Group discussion	Homework reports
3.0	**Values, autonomy, and responsibility**			
3.1	Show responsibility for working independently and for continuous improvement of personal capacities.	V1	Group discussion	Project
3.2	Be able to prepare a written scientific report.	V3	Lab work Groups discussion	Homework reports and lab reports

C. Course Content

No	List of Topics	Contact Hours
1	Chapter 1: Introduction and general concept: ▪ Nature of light ▪ Electromagnetic theory ▪ Quantum theory ▪ Modern optics	6
2	Chapter 2: Characteristics of Lasers: ▪ The meaning of Laser ▪ Laser history ▪ Light-matter interaction: absorption, spontaneous & stimulated emissions ▪ Optical properties of lasers	6
3	Chapter 3: Energy Levels, Radiative and Nonradiative Transitions ▪ Atomic models: Thomson's, Rutherford's and modern atomic models ▪ Particles statistics ▪ Radiative and non-radiative transitions ▪ Einstein's equations ▪ Saturation ▪ Molecular energy levels ▪ Energy levels in solids	5
4	Chapter 4: Laser components: ▪ Basic elements of a laser device: ▪ Active medium ▪ Pumping: optical, electrical, chemical and nuclear ▪ Resonators: stability of Resonators ▪ Laser cavity modes	5

	▪ Oscillators and amplifiers ▪ Resonator quality factor	
5	Chapter 5: Laser systems and lasing production: ▪ Three- and four-level laser systems ▪ Population inversion in Laser and Lasing threshold ▪ Laser gain ▪ Laser output power optimization ▪ Laser efficiency ▪ Effective medium	6
6	Chapter 6: Time dependent laser behaviours ▪ Q-switching ▪ Mode-locking ▪ Gain switching ▪ Linewidth broadening mechanism ▪ Spectral hole burning ▪ Spiking	6
7	Chapter 7: Lasers types: ▪ Gas lasers: atomic, ionic and molecular lasers ▪ Liquid lasers ▪ Solid-state lasers ▪ Semiconductor Laser ▪ Other lasers: X-ray lasers and free electron lasers	6
8	Chapter 8: Laser applications: ▪ Scientific applications ▪ Military applications ▪ Laser in Industry ▪ Medical applications ▪ Other applications	3
9	Chapter 9: Laser hazards and safety ▪ Laser classes ▪ Safety requirements and procedures	2
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	1st periodic exam	8th	20%
2.	Activities	periodically	10%
3.	Weekly practical reports	continuous	10%
4.	2nd periodic exam	14th	10%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
5.	Final practical exam	15th	10%
6.	Final exam	16th	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	1- Introduction to lasers and their application, Donald.C. Oshea Jersey 07458, 1995 2- Lasers theory and practice, J. Hawkes and I. Latimer, New York : Prentice Hall (1995).
Supportive References	1- Principles of lasers, Orazio. Svelto, Published 1998, springer 2- Laser fundamentals, William T. Silfvast, Published 1996, Cambridge Press
Electronic Materials	http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
Other Learning Materials	Multi media / CD associated with the text.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- Lecture room with max 50 seats. - Laboratories with max 15 places.
Technology equipment (projector, smart board, software)	- Computer room containing at least 10 stations - Software (MATLAB, Mathematica, Origin .....) - data show, Smart Board, software
Other equipment (depending on the nature of the specialty)	-Not applicable for this course

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of Students assessment	Program Leaders	Indirect
Quality of learning resources	Students Instructor Faculty	Indirect
The extent to which CLOs have been achieved	Program Leaders Instructor	Direct

Assessment Areas/Issues	Assessor	Assessment Methods
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	PHYSICS DEPARTMENT COUNCIL
REFERENCE NO.	NO. 4-45
DATE	27/09/2023 (12/03/1445)

قسم الفيزياء
Physics Department
TU
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TAIF UNIVERSITY