هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

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**

Table of Contents

A. Course Identification

1. Credit hours: 4
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 12th Level / 4th Year
4. Pre-requisites for this course (if any)**: Modern physics 2033105-4**
5. Co-requisites for this course (if any)**: Physical Optics 2033104-4**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	7	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Distance learning**	0	0%
5	**Other**	0	0%

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	50
2	**Laboratory/Studio**	20
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	70

B. Course Objectives and Learning Outcomes

1. Course 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.

2. Course Main Objective

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.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Describe laser operation and gain saturation.	K3
1.2	Recognize the physics governing laser behaviour and light matter interaction experimentally.	K3
1.3	Summarize information in different types of laser technology.	K3
2	**Skills :**	
2.1	Apply the principles of atomic physics to materials used in lasers and optics.	S1
2.2	Develop problem solving skills in laser physics	S2
3	**Values:**	
3.1	Show responsibility for working independently and for continuous improvement of personal capacities.	V1
3.2	Be able to prepare a written scientific report.	V3

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 ▪ Oscillators and amplifiers ▪ Resonator quality factor	5
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	6

	▪ Effective medium	
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	6
9	Chapter 9: Laser hazards and safety ▪ Laser classes ▪ Safety requirements and procedures	4
Total		50

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	Describe laser operation and gain saturation.	Group discussion	Quizzes
1.2	Define the physics governing laser behaviour and light matter interaction.	Lecture and Group discussion	Written exam
1.3	Summarize information in different types of laser technology.	Lecture Discussion	Written exam
2.0	**Skills**		
2.1	Apply the principles of atomic physics to materials used in lasers and optics.	Lectures	Written exam and Homework reports
2.2	Develop problem solving skills in laser physics	Lecture and Group discussion	Homework reports
3.0	**Values**		
3.1	Show responsibility for working independently and for continuous improvement of personal capacities.	Group discussion	Project
3.2	Be able to prepare a written scientific report.	Lab work Groups discussion	Homework reports and lab reports

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm exam	6th	20%
2	Activities	periodically	10%
3	Weekly practical reports	continuous	20%
4	Final practical exam	10th	10%
5	Final exam	11th	40%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

- Each faculty member is assigned a group of students for continuous academic advice during six weekly office hours (6 hrs./week).
- Also teaching staff are available for individual student consultations during this period.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	1- Principles of lasers, Orazio. Svelto, Published 1998, springer 2- Laser fundamentals, William T. Silfvast, Published 1996, Cambridge Press
Essential References Materials	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).
Electronic Materials	http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
Other Learning Materials	Multi media / CD associated with the text.

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	- Lecture room with max 50 seats. Laboratories with max 15 places.
Technology Resources (AV, data show, Smart Board, software, etc.)	- Computer room containing at least 10 stations - Software (MATLAB, Mathematica, Origin ……) data show, Smart Board, software
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	-Not applicable for this course

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Student Feedback on Effectiveness of Teaching	Students	Indirect
Evaluation of Teaching	Pear reviewer Program coordinator Departmental council Faculty council	Indirect
Improvement of Teaching	Program coordinator Relevant committee	Direct
Quality of learning resources	Students Instructor Faculty	Indirect
Extent of achievement of course learning outcomes,	Program coordinator Instructor	Direct
Course effectiveness and planning for improvement	Program coordinator Instructor	Indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Prof. Najm Al-Hosiny** **Dr. Sami Saeed Alharthi**
Reference No.	
Date	October 2, 2022