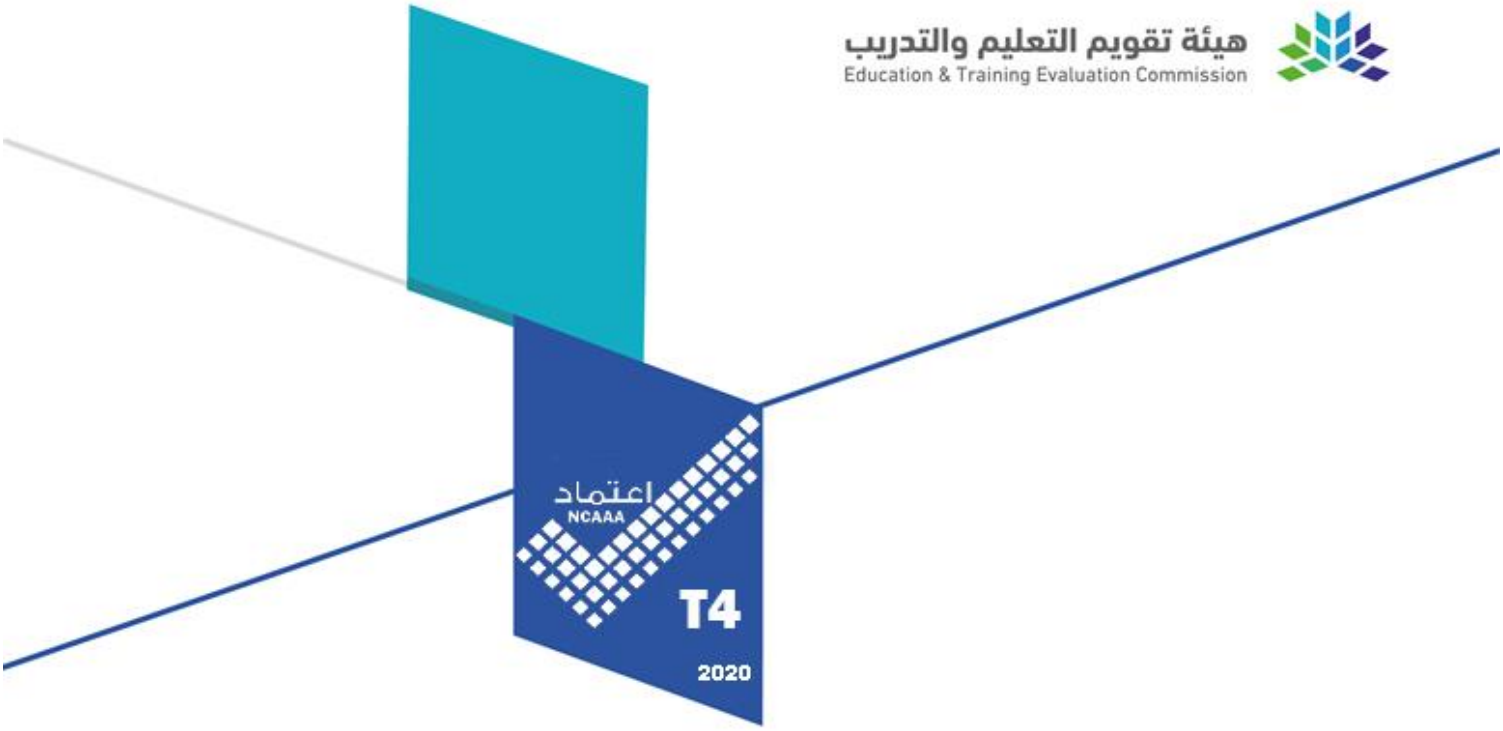
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Laser and its Applications**
Course Code:	**412PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 7/ Year 4
4. Pre-requisites for this course (if any)**: 312 PHYS**
5. Co-requisites for this course (if any)**: NIL**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**38**	**84%**
2	**Blended**	**7**	**16%**
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**42**
2	**Laboratory/Studio**	**--**
3	**Tutorial**	**3**
4	**Others** (specify)	
	Total	**45**

B. Course Objectives and Learning Outcomes

1. Course Description

This course is designed to provide students with the fundamentals of laser oscillation, its properties and applications. It describes the interaction of photon with matter and covers the essential laser requirements, laser gain media, laser oscillations inside various resonators, and their stability conditions. It also discusses the laser beam characteristics, transformation, and mode structure. It enables students to explore some of the laser types and the related aspects of various technological applications that employ lasers and beam optics.

2. Course Main Objective

This course is designed to provide students with:

- The fundamentals and principles of light matter interactions.
- The essential concepts of laser oscillations, its operational requirements and laser beam properties.
- Adequate skills of formulations of laser rate equations in various systems, laser threshold conditions and some of the laser types and their characteristics.

- The basic analysis of the continuous-wave and pulsed laser operation using appropriate formalisms.
- The criteria for assessment of optical resonator stability and mode structure.

The basics of some laser applications.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**Define** the main requirements of laser operation , beam properties and various processes in laser matter interaction	**PLO1.1**
1.2	**Describe** the laser beam parameters, various processes in laser oscillation, laser beam characteristics, and the suitable laser type for various applications	**PLO1.1**
1.3	**Discuss** various process in laser matter interaction, the stability of optical resonator, the output operation and mode structure, various parameters of different laser types and laser applications in various fields	**PLO1.2**
2	**Skills :**	
2.1	**Solve** problems related to laser matter interaction, stability of laser cavity, laser oscillations and laser beam characteristics	**PLO2.1**
2.2	**Derive** the Einstein relations, laser gain and other laser parameters from the laser rate equations and oscillation processes	**PLO2.2**
2.3	**Develop** critical thinking competencies on the analysis of laser principles, characteristics and applications	**PLO2.4**
2.4	**Demonstrate** communication skills during interactive discussion, group assignments, essays or web-based activities.	**PLO2.4**
3	**Values:**	
3.1	**Show** effective collaboration and bear individual responsibility during group work and/or assignments	**PLO3.1**
3.2	**Adopt** some practices of self and long life learning in the field of laser and its important applications through some essays and case studies	**PLO3.2**

C. Course Content

No	List of Topics	Contact Hours
1	**Laser Fundamentals:** The nature of light, Blackbody Radiation, The Einstein relations (Emission + Absorption), Rate equations (gain and population inversion), Pumping methods, Three and Four level systems, and Threshold condition of laser oscillation.	**12**
2	**Laser beam propagation and transformation:** Resonators and stability condition**,** Laser Modes (transverse and longitudinal modes)**.**	**6**
3	**Properties of Laser Radiation:** Coherence, Monochromaticity, Directionality, Focusing, and Brightness.	**3**
4	**Some types of lasers:** Gas lasers {Atomic (He-Ne)- Ionic (Argon)- Molecular (CO_2 , Excimer), Solid State Lasers (Raby, Nd:YAG, Ti:Sapphire), Semiconductor Lasers (GaA1As), Free electron laser	**9**
5	**Laser output:** Q-Switching, Methods of Q-Switch, Mode locking, and Methods of Mode Locking	**6**
6	**Laser's Applications:** Optical communication**,** Metrological and Scientifi Application**,** Medical, Industrial and Military Applications**,** Commercial an Information Applications**,** Holography and its Applications.	**6**

7	**Review**	**3**
Total		**45**

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	**Define** the main requirements of laser operation , beam properties and various processes in laser matter interaction	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
1.2	**Describe** the laser beam parameters, various processes in laser oscillation, laser beam characteristics, and the suitable laser type for various applications	Lectures, blackboard and diagram illustration, group discussion, Interactive illustrations- Student contribution	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
1.3	**Discuss** various process in laser matter interaction, the stability of optical resonator, the output operation and mode structure, various parameters of different laser types and laser applications in various fields	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.0	**Skills**		
2.1	**Solve** problems related to laser matter interaction, stability of laser cavity, laser oscillations and laser beam characteristics	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.2	**Derive** the Einstein relations, laser gain and other laser parameters from the laser rate equations and oscillation processes	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.3	**Develop** critical thinking competencies on the analysis of laser	Lectures, blackboard and visualization, brain	**Direct** (formative and summative): In

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	principles, characteristics and applications	storming, group and interactive discussion, Interactive illustration – Problem based learning	class interactive questioning, quizzes, written exams **Indirect:** student survey
2.4	**Demonstrate** communication skills during interactive discussion, group assignments, essays or web-based activities.	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
3.0	**Values**		
3.1	**Show** effective collaboration and bear individual responsibility during group work and/or assignments	Interactive and Group discussion, expository and discovery teaching	**Direct** (formative and summative): interactive questioning- group assignment **Indirect**: student survey
3.2	**Adopt** some practices of self and long life learning in the field of laser and its important applications through some essays and case studies	Discussion - Brain storming -guided group analysis	**Direct** (formative): - essays assignment- case study) **Indirect**: student survey- viva

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Homework assignment- Contribution in interactive discussion- Group work or Project**	**3**	**3** (3%)
2	**Lecture Quiz 1**	**4**	**5** (5%)
3	**First Mid-term exam**	**6**	**15** (15%)
4	**Homework assignment- Contribution in interactive discussion- Group work or Project**	**10**	**3** (3%)
5	**Lecture Quiz 2**	**11**	**5** (5%)
6	**Second mid-term exam**	**12**	**15** (15%)
7	**Homework assignment- Contribution in interactive discussion- Group work-essay or Project discussion**	**11**	**4** (4%)
9	**Final Exam**	**16**	**50** (50%)

***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 group of students is assigned to a staff member who will be available for help and academic guidance office hours at specific 2h on daily basis.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Lasers and Electro-optics: Fundamentals and Engineering, Christopher C. Davis, Cambridge University Press, 2nd Ed., 2014
Essential References Materials	-Principles of Laser, Orazio Svelto- Translated by *David C. Hanna*, Springer, 5th Ed.2013 -Laser Fundamentals, William T. Silfvast, Cambridge University Press; 2nd Ed. 2008
Electronic Materials	**http://ocw.mit.edu/courses/physics/** **http://laserworld.com** **http://www.physics.org/explore.asp** **http://www.wikipedia.org/**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Class room- if possible room for interactive discussion (round table)
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show- smart board
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	none

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Assessment	Students, Program assessment committee	Direct/ Indirect
Extent of achievement of course learning outcomes	Instructor	Direct/Indirect
Quality of learning resources	Students, Faculty members	Indirect
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation

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	
Reference No.	
Date	