هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	**laser and its applications**
Course Code:	**412PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**
Version:	**2022**
Last Revision Date:	**November 2022**

Table of Contents:

A. General information about the course:

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 10/ Year 4**				
4. Course general Description					
This course is designed to provide students with the fundamentals of laser oscillation, its properties and applications. It describes the interaction of photons 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					
5. Pre-requirements for this course (if any): 342PHYS					
6. Co- requirements for this course (if any): NIL					
7. Course Main Objective(s)					

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 in 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

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	28	85
2.	E-learning	5	15
3.	Hybrid ● Traditional classroom ● E-learning		
4.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	30
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	3
5.	Others (specify)	
	Total	33

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	**Define** the main requirements of laser operation, beam properties and various processes in laser matter interaction	**PLO1.1**	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	**PLO1.1**	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	**PLO1.2**	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	**PLO2.1**	Lectures, blackboard and visualization, brainstorming, 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	**PLO2.2**	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			illustration – Problem based learning	**Indirect**: student survey
2.3	**Develop** critical thinking competencies on the analysis of laser principles, characteristics and applications	**PLO2.4**	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
2.4	**Demonstrate** communication skills during interactive discussion, group assignments, essays or web-based activities, self-learning awareness	**PLO2.4**	Lectures, blackboard and visualization, brainstorming, 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, autonomy, and responsibility			
3.1	**Show** effective collaboration and bear individual responsibility during group work and/or assignments	**PLO3.1**	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	**PLO3.2**	Discussion - Brainstorming - guided group analysis	**Direct** (formative): - essays assignment- case study) **Indirect**: student survey- viva
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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.	**8**
2.	**Laser beam propagation and transformation:** Resonators and stability condition**,** Laser Modes (transverse and longitudinal modes)**.**	**5**
3.	**Properties of Laser Radiation:** Coherence, Monochromaticity, Directionality, Focusing, and Brightness.	**4**
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	**7**
5.	**Laser output:** Q-Switching, Methods of Q-Switch, Mode locking, and Methods of Mode Locking	**4**
6.	**Laser's Applications:** Optical communication**,** Metrological and Scientifi Application**,** Medical, Industrial and Military Applications**,** Commercial an Information Applications**,** Holography, and its Applications.	**5**
Total		**33**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Assignment 1**	**3**	**3** (3%)
2.	**Assignment 2**	**4**	**3** (3%)
3.	**Quiz I**	**5**	**5** (5%)
4.	**Mid-term exam**	**6**	**20** (20%)
5.	**Others (Group work, Essay, Attendance, class discussion participation)**		**8** (8%)
6.	**Assignment 3**	**8**	**3 (**3%**)**
7.	**Quiz II**	**10**	**5** (5%)
8.	**Assignment 4**	**11**	**3** (3%)
9	**Final Exam**	**12**	**50** (50%)

*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	Lasers and Electro-optics: Fundamentals and Engineering, Christopher C. Davis, Cambridge University Press, 2nd Ed., 2014
Supportive References	-Principles of Laser, Orazio Sevelto- 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**

Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom- if possible room for interactive discussion (round table)
Technology equipment (Projector, smart board, software)	Data show- smart board
Other equipment (Depending on the nature of the specialty)	none

F. Assessment, of Course, Quality

Assessment Areas/Issues	Assessor	Assessment 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
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	DEPARTMENT BOARD
REFERENCE NO.	PHYS2304
DATE	28/2/2023