Syllabus*: Course Title and Code : Laser Physics (110102464)

Second Semester 2021/2022

COURSE INFORMATION	
Course Title: Laser Physics **Semester:** Second **Department:** Physicis **Faculty: Science**	**Course Code:** 110102464 **Section:** 1 **Core Curriculum**: B. Sc. of Science in Physics
Day(s) and Time(s): Sun, Tue, Thu 11:00-12:00 Am **Classroom:** Al-Hussain Room # 207	**Credit Hours:** 3 **Prerequisites**: 110102102

COURSE DESCRIPTION

The course introduces physical foundations for lasers, including light-matter interaction phenomena, propagation of laser beams, laser resonators, rate equations for lasers, transient laser phenomena, principles and characteristics of cw and pulsed lasers, and some topical laser applications as a case study.

DELIVERY METHODS

The course will be delivered through a combination of active learning strategies. These will include:

- PowerPoint lectures and active classroom-based discussion.
- Collaborative learning through small groups acting in an interdisciplinary context.
- Relevant films and documentaries.
- Video lectures.
- E-learning resources: e-reading assignments and practice quizzes through Model and Microsoft Team .

FACULTY INFORMATION

Name	**Wa'el Salah**
Academic Title:	Professor
Office Location:	Physics Building, Room # 209
Telephone Number:	
Email Address:	wsalah@hu.edu.jo
Office Hours:	Sun, Tue, Thu 11-12 Am Please send an e-mail (wsalah@hu.edu.jo) to meet at any other time.

REFERENCES AND LEARNING RESOURCES
Required Textbook: **Textbook(1):** "Laser Electronics", Joesph T. Verdeyen, Prentice Hall, 1995, Third edition. **Textbook(2):** Principles of Lasers, by O. Svelto. 4th. Edition Plenum press, 1998. **Suggested Additional Resources**: Lasers Theory and Practice, by J. Hawkes and I. Latimer. Prentice Hall 1995. Laser Engineers, by Kelin J. Kuhn, Prentice Hall, Inc., 1998. Laser Physics, Simon Hooker and Colin Webb, Oxford University press, **Useful Web Resources**: http://www.

STUDENT LEARNING OUTCOMES MATRIX*

Core Curriculum Learning Outcomes	Program Learning Outcomes	Course Objectives	Course Student Learning Outcomes	Assessment Method
CC-LO-5 Think critically and creatively in a variety of methods in order to make decisions and solve problems.	PHYS-LO-1: Apply critical thinking and demonstrate problem-solving skills in two or more of the major fields of physics.	1. Develop an understanding of the basic principles of the major branches of physics.	1. Develop a clear understanding of basic physical phenomena in thermal physics and materials science as an integral part of the student's overall education	● Exams ● Quizzes ● "On-line' reading assignments ● homework assignments
		2. Obtain a thorough foundation in the various fields of physics.	2. Explain natural phenomena using simple physics concepts.	● Exams ● Quizzes ● "On-line' reading assignments
		3. Learn to solve physics problems using basic mathematics and Laser principles..	3. Use algebra, trigonometry, and basic calculus, in solving problems in Laser physics and Laser cavity	● Exams ● Quizzes ● "On-line' reading assignments ● homework assignments
		4. Develop an understanding of models and theories of physics	4.1 Describe the electronic structure of the atoms using quantum numbers, orbital diagrams and electron configurations. 4.2 Provide detailed and accurate description of ABCD ray tracing in an optical cavity	● Exams ● Quizzes ● "On-line' reading assignments ● homework assignments
.CC-LO-4. Communicate competently with others using oral and written English skills	PHYS-LO-4: Use modern literature search methods to obtain information about physics topics and write reports.	5. Obtain an understanding of the role of physics in other disciplines, and its importance in society.	5. Acquire the ability to learn independently; articulate the importance of independent learning for future professional development	● "On-line" reading assignments ● Term project

CC-LO-6. Demonstrate competency in the use of research skills and various information sources. CC-LO-7. Identify the general concepts of humanities and natural sciences in a manner that reveals their value in life.	PHYS-LO-6: Communicate results to physicists and non-physicists.	6. Acquire positive attitudes towards further studies in physics and towards the application of physics in other disciplines.	6. Develop a positive attitude towards physics and its applications in society, and towards further study and lifelong learning.	● Term project

* يتم تعديلها وفقا لما يتم تحديده لكل مساق بالتنسيق مع الكلية والقسم المعني

ACADEMIC SUPPORT

It is The Hashemite University policy to provide educational opportunities that ensure fair, appropriate and reasonable accommodation to students who have disabilities that may affect their ability to participate in course activities or meet course requirements. Students with disabilities are encouraged to contact their Instructor to ensure that their individual needs are met. The University through its Special Need section will exert all efforts to accommodate for individual's needs.

Special Needs Section: N.A
Tel:
Location:
Email:

COURSE REGULATIONS

Participation

Class participation and attendance are important elements of every student's learning experience at The Hashemite University, and the student is expected to attend all classes. A student should not miss more than 15% of the classes during a semester. *Those exceeding this limit of 15% will receive a failing grade regardless of their performance*. It is a student's responsibility to monitor the frequency of their own absences. **Attendance record begins on the first day of class irrespective of the period allotted to drop/add and late registration. It is a student's responsibility to sign-in; failure to do so will result in a non-attendance being recorded.**

In exceptional cases, the student, with the instructor's prior permission, could be exempted from attending a class provided that the number of such occasions does not exceed the limit allowed by the University. The instructor will determine the acceptability of an absence for being absent. A student who misses more than 25% of classes and has a valid excuse for being absent will be allowed to withdraw from the course.

Plagiarism

Plagiarism is considered a serious academic offence and can result in your work losing marks or being failed. HU expects its students to adopt and abide by the highest standards of conduct in their interaction with their professors, peers, and the wider University community. As such, a student is expected not to engage in behaviors that compromise his/her own integrity as well as that of the Hashemite University.

Plagiarism includes the following examples and it applies to all student assignments or submitted work:

- **Use of the work, ideas, images or words of someone else without his/her permission or reference to them.**
- **Use of someone else's wording, name, phrase, sentence, paragraph or essay without using quotation marks.**
- **Misrepresentation of the sources that were used.**

<u>The instructor has the right to fail the coursework or deduct marks where plagiarism is detected</u>

Late or Missed Assignments

In all cases of assessment, students who fails to attend an exam, class project or deliver a presentation on the scheduled date without prior permission, and/or are unable to provide a medical note, will automatically receive a fail grade for this part of the assessment.

- Submitting a term paper on time is a key part of the assessment process. Students who fail to submit their work by the deadline specified will automatically receive a 10% penalty. Assignments handed in more than 24 hours late will receive a further 10% penalty. Each subsequent 24 hours will result in a further 10% penalty.
- In cases where a student misses an assessment on account of a medical reason or with prior permission; in line with University regulations an incomplete grade for the specific assessment will be awarded and an alternative assessment or extension can be arranged.

Student Complaints Policy

Students at The Hashemite University have the right to pursue complaints related to faculty, staff, and other students. The nature of the complaints may be either academic or non-academic. For more information about the policy and processes related to this policy, you may refer to the students' handbook.

COURSE ASSESSMENT

Course Calendar and Assessment

Students will be graded through the following means of assessment and their final grade will be calculated from the forms of assessment as listed below with their grade weighting taken into account. The criteria for grading are listed at the end of the syllabus

Assessment	Grade Weighting	Deadline Assessment
e.g. Exam 1	e.g. 25%	Add date/time
e.g. Exam 2	e.g. 25%	Add date/time
e.g. Quizzes	5%	-
e.g. Homework	5%	-
e.g. Final Exam (3)	e.g. 40%	Add date/time

Description of Exams

Test questions will predominately come from material presented in the lectures. Semester exams will be conducted during the regularly scheduled lecture period. Exam will consist of a combination of multiple choice, short answer, match, true and false and/or descriptive questions.
Homework: Will be given for each chapter, while the chapter in progress you are supposed to work on them continuously and submit in next lecture when I finish the chapter.
You are also expected to work on in-chapter examples, self-tests and representative number of end of chapter problems. The answers of self-tests and end of chapter exercises are given at the end of the book.

Quizzes: Unannounced quizzes will be given during or/and at the end of each chapter based upon the previous lectures. It will enforce that you come prepared to the class.

No make-up exams, homework or quizzes will be given. Only documented absences will be considered as per HU guidelines.

Grades are not negotiable and are awarded according to the following criteria*:

Letter Grade	Description	Grade Points
A+	Excellent	4.00
A		3.75
A-		3.50
B+	Very Good	3.25
B		3.00
B-		2.75
C+	Good	2.50

C		2.25
C-		2.00
D+	Pass	1.75
D	Pass	1.50
F	Fail	0.00
I	Incomplete	-

* يمكن التعديل حسب طبيعة البرنامج (بكالوريوس/دراسات عليا)

WEEKLY LECTURE SCHEDULE AND CONTENT DISTRIBUTION

مثال على التوزيع : مساق الكيمياء العامة 101

"Lecture hours and weeks are approximate and may change as needed"

Textbook			
Chapter 2	**Ray tracing in an optical system**	**Week 1-2**	**6 lecture hours**
2. 1	**Introduction**		
2. 2	**Ray Matrix**		
2. 3	**Some common ray matrices**		
2. 4	**Application of ray tracing: optical cavities**		
2.5	**Stable and Unstable cavities, Stability diagram**		
Assignment I			
Chapter 3	**Gaussian Beam**	**Week 3-4**	**6 lecture hours**
3 .1	**TEM Waves**		
3. 2	**Physical description of TEM_{00} mode**		
3. 3	**ABCD law for Gaussian beam**		
3 .3.1	**Amplitude of the field**		
3. 3. 2	**Longitudinal phase factor**		
3 .3. 3	**Radial phase factor**		
3. 4	**Higher order mode**		
Assignment II			
	First Exam		
Chapter 5	**Optical cavities**	**Week 5-6**	**6 lecture hours**
5. 1	**Introduction**		
5. 2	**Gaussian beam in simple stable resonators**		
5. 3	**Application of ABCD law to cavities**		
5. 4	**Mode volume in stable resonators**		
Assignment III			
Chapter 6	**Resonant optical cavities**	**Week 7-8**	**6 lecture hours**
6. 1	**General cavity concepts**		
6. 2	**Resonance**		
6 .3	**Sharpness of resonance: Quality factor and finesse**		
6. 4	**Photon lifetime**		
6 .5	**Resonance of the Hermite-Gaussian modes**		

6 .6	**Diffraction losses**		
6.7	**Cavity with gain:**		
6. 8	**Examples**		
Assignment IV			
Second Exam			
Chapter 7	**Atomic Radiation**	**Week 9-11**	**9 lecture hours**
7.1	**Black body radiation**		
7. 2	**Einstein's approach: A and B coefficients**		
7. 2. 1	**Definition of radiative processes**		
7. 2. 2	**Relationships between coefficients**		
7. 3	**Line shape**		
7.4	**Amplification by an atomic system**		
7.5	**Broadening of spectral lines**		
Assignment V			
Chapter 8	**Laser oscillation and amplification**	**Week 12-14**	**9 lecture hours**
8.1	**Threshold condition for oscillation**		
8. 2	**Laser oscillation and amplification in a homogeneous broadened transition**		
8. 3	**Gain saturation in a homogeneous broadened transition**		
8. 4	**Laser oscillation in an inhomogeneous system**		
8. 5	**Multimode oscillations**		
8. 6	**Gain saturation in Doppler-Broadened transition: Mathematical treatment**		
8. 7	**Amplified spontaneous emission**		
8.8	**Laser oscillation: A different viewpoint**		
Assignment 6			
Review		**Week 15**	**3 lecture hours**
University Exams		**Week 16**	

ASSESSMENT RUBRICS

Classroom Participation: Assessment Criteria					
Criteria	**Quality**				**Score**
	Excellent (4 points)	**Good (3 points)**	**Satisfactory (2 points)**	**Needs Improvement (1 points)**	

Degree to which student integrates course readings into classroom participation	- often cites from readings; - uses readings to support points; - often articulates "fit" of readings with topic at hand.	-occasionally cites from readings; - sometimes uses readings to support points; -occasionally articulates "fit" of readings with topic at hand **.**	-rarely able to cite from readings; - rarely uses readings to support points; - rarely articulates "fit" of readings with topic at hand	-unable to cite from readings; -cannot use readings to support points; cannot articulates "fit" of readings with topic at hand .	2
Interaction/ participation in classroom discussions	-always a willing participant, responds frequently to questions; - routinely volunteers point of view .	-often a willing participant, - responds occasionally to questions; - occasionally volunteers point of view .	-rarely a willing participant, - rarely able to respond to questions; - rarely volunteers point of view .	-never a willing participant., - never able to respond to questions; - never volunteers point of view .	2
Interaction/participation in classroom learning activities	-always a willing participant; -acts appropriately during all role plays; - responds frequently to questions; - routinely volunteers point of view.	-often a willing participant; -acts appropriately during role plays; - responds occasionally to questions; -occasionally volunteers point of view.	-rarely a willing participant. -occasionally acts inappropriately during role plays; - rarely able to respond to direct questions; -rarely volunteers point of view .	-never a willing participant - often acts inappropriately during role plays;, - never able to respond to direct questions; - never volunteers point of view.	3
Demonstration of professional attitude and demeanor	-always demonstrates commitment through thorough preparation; - always arrives on time; - often solicits instructors' perspective outside class.	- rarely unprepared; rarely arrives late; - occasionally solicits instructors' perspective outside class **.**	-often unprepared; occasionally arrives late; - rarely solicits instructors' perspective outside class .	-rarely prepared; - often arrives late; -never solicits instructors' perspective outside class	2

Assessment Rubrics to be determined by the department. Add samples below.

Classroom Participation: Oral Presentation				
Element	**Excellent**	**Satisfactory**	**Needs Improvement**	**Points**

	8	7	6	5	4	3	2	1	0	
Organization	There is a logical sequence of information. Title slide and closing slide are included appropriately.			There is some logical sequence of information. Title slide and closing slides are included.			There is little or no logical sequence of information. Title slide and/ or closing slides are not included.			7
Slide Design (text, colors, background, illustrations, size, titles, subtitles)	Presentation is attractive and appealing to viewers.			Presentation is somewhat appealing to viewers.			Little to no attempt has been made to make presentation appealing to viewers.			7
Content	Presentation covers topic completely and in depth. Information is clear, appropriate, and accurate.			Presentation includes some essential information. Some information is somewhat confusing, incorrect, or flawed.			Presentation includes little essential information. Information is confusing, inaccurate, or flawed.			7
Language	Spelling, grammar, usage, and punctuation are accurate Fluent and effective			There are minor problems in spelling, grammar, usage, and/or punctuation.			There are persistent errors in spelling, grammar, usage, and/or punctuation. Less or not fluent and effective.			7
Delivery	Ideas were communicated with enthusiasm, proper voice projection and clear delivery. There was sufficient eye contact with audience. There were sufficient use of other non-verbal communication skills. Appropriate delivery pace was used.			There was some difficulty communicating ideas due to voice projection, lack of preparation, incomplete work, and/or insufficient eye contact. Insufficient use of non-verbal communication skills. Delivery pace is somewhat appropriate.			There was great difficulty communicating ideas due to poor voice projection, lack of preparation, incomplete work, and/or little or no eye contact. No use of non verbal communication skills. Inappropriate delivery pace was used.			7
Interaction with Audience	Answers to questions are coherent and complete. Answers demonstrate confidence and extensive knowledge.			Most answers to questions are coherent and complete. Answers somehow demonstrate confidence and extensive knowledge.			Answers to questions are neither coherent nor complete. Is tentative or unclear in responses.			7
	Total Score (Y x 5/16) =									

- يمكن اجراء التعديلات المناسبة حسب طبيعة المقرر وبالتنسيق مع الكلية المعنية وتحديد أنواع التعلم بوضوح (الكتروني، مدمج، وجاهي) ونماذج التعلم (نسبة التعلم الوجاهي الى الألكتروني ونسبة التعلم المتزامن الى غير المتزامن) التي سوف يتم اتباعها أثناء تدريس المساقات وبما يتوائم مع نسب الادماج المشار اليها في كتاب مجلس التعليم العالي رقم مع/.1427 .

Prepared by: Professor Wa'el Salah **Date: March**, 15, 2022