

Ministry of Higher Education and Scientific Research

Supervision and Scientific Evaluation Department

Quality Assurance and Academic Accreditation Office

laser principles Course Description

The template provides a summary of the main course features and expected student learning outcomes.

1. Educational Institution	Shatt Al-Arab University
2. Department / Center	Department of Laser and Optoelectronics Engineering
3. Course Title /Code	laser principles
4. Lecturer Name	Alaa Naser Khraibet
5. Type of Teaching	Attendance
6. Academic Year /Term	Term
7. Total No. of Teaching Hours	175
8. Date of Preparing this Course Description	28/7/2025

1. Course Objectives

This comprehensive course provides a basic understanding of the principles of lasers.

- It covers how lasers are produced, how their properties are controlled, and their interactions with different materials.
- It also includes a study of the principles of stimulated emission, the formation of laser beams, and their unique properties (functionality, parallelism, monochromaticity, and directivity), as well as an introduction to different types of lasers, such as solid-state lasers and gas lasersLiquid lasers and semiconductor lasers.
- Understand how each type works. Train students to use different laser devices, understand how they work, and perform basic maintenance..

2. Course Output, Methodology and Evaluation

(A) Cognitive Objectives

- A- • Predict the main (and final) properties of laser systems on specific laser materials, such as output power and laser threshold.
- B- • Evaluate and design optical cavities for different laser systems.
- C- • Determine laser control over the head and contact.
- D- • Solve the modified equations in a hypothetical laser case.
- C- • Find the interrelationships between Einstein's propositions.

(B) Skill Objectives Related to the Program:

- The skill objectives for laser principles include understanding the basics of laser operation and its various applications in diverse fields, as well as practical skills in handling and using various laser devices safely. Understanding how lasers work, starting with the stimulated emission of photons, moving on to the mechanism of forming a coherent laser beam, and ending with the different types of lasers and their uses.

(C) Methods of Teaching and Learning

- Delivering Pre-Prepared Lectures.
- Assigning Homework.
- Facilitating Group Discussions.

(D) Methods of Evaluation

- **Oral Tests:** Assessing students' understanding through verbal responses.
- **Monthly Tests:** Evaluating students' knowledge and progress on a monthly basis.
- **Daily Quizzes:** Regular quizzes to gauge students' grasp of material covered each day.
- **Regular Attendance:** Monitoring and evaluating students' consistent participation in

classes.

(E) Sentimental and Value Objectives

- **Ethical Understanding:** Promoting respect, integrity, and social responsibility.
- **Attitudes and Values:** Fostering positive attitudes towards learning, collaboration, and ethical behavior.

(F) General and Qualitative Skills (other skills related to the ability of employment and personal development)

- Develop students' leadership skills.
- • Improve students' proficiency in presenting technical information, writing reports, and explaining results.
- • Develop students' technical skills through their participation in practical experiments related to laser principles.
- • Encourage students to adapt to new technologies and methodologies related to laser principles.

3. Course Structure

Week	No of Hours	Required Learning Output	Title of Subject	Teaching Method	Evaluation
1		To be able to: identify the different types of electromagnetic waves, describe their basic properties (wavelength and frequency), determine the units of measurement for these properties, and understand the uses of each type of wave in various fields.	The electromagnetic spectrum , units	Lectures and discussions	Oral tests and questions
2		Includes a deep understanding of laser	Laser process	Lectures and discussions	Oral tests and questions

		fundamentals, including its working principles, types, and various applications.			
३		Understanding the absorption of electromagnetic radiation includes: understanding the concept of absorption, knowing the factors affecting it, and describing the different absorption effects.	Absorption of electromagnetic Radiation	Lectures and discussions	Oral tests and questions
४		It's important to understand that the inverse structure is the second principle of laser operation, whereby atoms in the higher energy level outnumber those in the lower energy level. This allows stimulated emission, which is what generates photons in the laser. and understand the phase rule and its applications	Population inversion	Lectures and discussions	Oral tests and questions
५		Includes understanding the relationship between Einstein A and B coefficients, how they relate to spontaneous and stimulated emission and absorption in a laser material, as well as the ability to apply these concepts to different types of lasers, including	Einstein Coefficients. Lasing Processes , Three- and Four- Level Lasers	Lectures and discussions	Oral tests and questions

		three- and four-level lasers			
٦		The ability to describe how an optical resonator works, identify the basic components of a laser, explain the function of each component, and understand how an optical resonator works to amplify light and produce a laser beam.	The Optical Resonator, Basic components of a Laser system	Lectures and discussions	Oral tests and questions
٧		Applying the laws of blackbody radiation, such as Wien's law and the Stefan-Boltzmann law, atoms and molecules have specific energy levels, and electrons can only exist in these levels.	Light and Blackbody Emission , Energy Levels, Radiative and Nonradiative Transitions in Molecules	Lectures and discussions	Oral tests and questions
٨		Understand the basic properties of lasers, such as monochromaticity, coherence, and parallelism, as well as concepts such as laser gain, linewidth, laser threshold, threshold gain calculation, selective pumping, the continuous-phase laser effect, and thermal density effects in molecules.	Properties of Laser Radiation . Laser Gain. Linewidth. Thresholds for Lasing. Calculating Threshold Gain. Selective Pumping.. CW Lasing Action. Thermal Population Effects.	Lectures and discussions	Oral tests and questions
٩		They are the working principles of each type, the materials used, and the different applications.	Solid-State, Dye, and Semiconductor Lasers	Lectures and discussions	Oral tests and questions

1.		Understand how gas is excited to produce laser light. Understand how lasers are produced through chemical reactions and how lasers work using beams of high-speed electrons.	Gas, Chemical, Free Electron, and X-Ray Lasers	Lectures and discussions	Oral tests and questions
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4. Lab Structure

Week	No of Hours	Materials Covered
1		Laser safety
2		Alignment of optical cavity
3		Laser beam divergence
4		Measurement of absorption coefficient of filter
5		Monochromatic light of single slit
6		Monochromatic light of Double slit
7		Diffraction By Transmission Grating

5. Learning and Teaching Resources

Textbooks	1. <i>Principles of Lasers</i> , by O. Svelto. 2- <i>Laser Fundamentals</i> by W. T. Silfvast Lasers, by A. Siegman Lasers fundamentals and applications by K. Thyagarajan, A. Ghatak.
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6. Course Improvement Plan

Updating and expanding the curriculum content to include modern developments and applications related to laser principles.
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