Course Specifications

General Information

Course name	Advanced Optics& Lazer
Course number	PHYS4326
Faculty	
Department	
Course type	Major Needs
Course level	4
Credit hours (theoretical)	3
Credit hours (practical)	0
Course Prerequisites	

Course Objectives

1 - To understand the principles of laser
2 - To explain the properties of laser light
3 - To understand the operations of different types of lasers
4 - To become familiar with laser safety
5 - To understand holography and its application
6 - To understand the basic fiber optic communication systems

Intended Learning Outcomes

Knowledge and Understanding

* On completion of this course a student should be able to demonstrate understanding of and be able to solve problems on
* 1) absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening , and the conditions for laser amplification,
* 2) operations of the Fabry-Perot cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media,
* 3) the four-level laser system, the simple homogeneous laser and its output behaviour and optimal operating conditions,
* 4) spectral properties of a single longitudinal mode, mode locked laser operation, schemes for active and passive mode locking in real laser system,
* 5) operations and basic properties of the most common laser types, He-Ne, Argon-ion, and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types,
* In addition each student will undertake a review article on a particular laser application and present their findings in a short oral presentation

Course Contents

1 - Essentials in Optics
2 - Laser Radiation and its properties
3 - Electromagnetic radiation
4 - Emission and absorption of light
5 - Einstein relation
6 - Natural line broadening, Doppler broadening, pressure broadening
7 - Small signal gain
8 - 3 level laser and 4 level laser
9 - Laser modes
10 - Rate equations
11 - Q-switching
12 - Mode locking
13 - Active medium
14 - Excitation mechanism
15 - Feedback mechanism
16 - Atom Gas: Helium-Neon Laser (He-Ne). Ion Gas, Argon Ion Laser
17 - Molecular Gas: Carbon Dioxide Laser (CO2). Nitrogen Laser (N2
18 - Solid State lasers: Ruby Laser. Neodimium YAG and Nd Glass Laser
19 - Diode Laser: (Semiconductor Laser, Injection Laser)
20 - Liquid Laser: Dye Laser
21 - Industrial applications
22 - Medical applications
23 - Scientific research applications

Teaching and Learning Methods

1 - Lectures
2 - Tutorial
3 - In-class exercise
4 - The presentation is designed to encourage students to research into individual topics about lasers. The topics include specific engineering applications of lasers, specifically popular lasers, or novel lasers. The students are expected to learn through actively researching and integrating the knowledge about the latest technological development in optoelectronics.: Oral presentation

Teaching and Learning Methods for the Disabled Students

1 - All the course lectures are video recorded and published on youtube

Students Assessment

Assessment Method	TIME	MARKS
Med Exam 1	45 min	20
Med Exam 2	45 min	20
Oral presentation	15 min	10

Books and References

Course note	http://physicsacademy.org
Essential books	A Yariv, Optical Electronics, 4th Edition, 1989
	O Svelto, Principles of Lasers, 4th and 5th Edition
Recommended books	CA Bennett, Principles of Physical Optics, 2008
	A Yariv, Quantum Electronics, 3rd Edition, 1984
Other References (Periodical, web sites, ... etc.)	https://www.youtube.com/watch?v=nCdURSjUTg0&list=PL1FA81C2C46A25EF2&spfreload=10