

**Laser Lab.**

# Course Book – (4th Year Physics– Applied Branch)

**Lecturer's name Dr. Amange Francis Boya**

**Msc. Samera Yousif**

**Academic Year: 2022/2023**

Course Book(Lab)

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| Laser (lab.) | 1-Course Name |
| **Dr. Amange Francis Boya** **Msc. Samera Yousif** | 2-Lab. Staff |
| E-mail: amange.boya@su.edu.krdWebsite | 3-Department/ College |
| Practical: 3 | 4-Contact |
| Wednesday 8:30 – 10:30 am,Wednesday 10:30 am – 12:30 pm,Wednesday 12:30 – 2:30 pm | 5-Time(In hours) per week |
| 10 h / week | 6-Office Hours |
| n/a | 7- Course Code |
|  | 8- Teacher's academic profile |
| N/A | 9- Keywords |
| 10- **Course Overview:**This module introduces Laser physics and emphasizes its roles in medicine especially in the treatment of cancer, Skin, tee . This course presents an overview of the fundamentals of Laser system, starting with an overview of laser properties and moving to simple experiment components and its application in medicine like **:measure the pulse duration, pulse repetition time, and average power of a repetitively pulsed laser and calculation the maximum power, pulse repetition rate, duty cycle, and energy per pulse, determine the Specific rotation of sugar solution and to determine the sugar concentration of unknown solution****And Measure of Doppler frequency and determination the velocity of blood**.  |
| 11- **Course Objective:****Develop basic understanding of laser physics concepts and it is application in medicine** **At the end of the course the student will:****1. Describe structure and operating principle of laser (semiconductor, gas and solid-state laser).****2. Describe physical mechanism of interaction of laser beam with Tissue.****3. to measure the pulse duration, pulse repetition time, and average power of a repetitively pulsed laser and calculation the maximum power, pulse repetition rate, duty cycle, and energy per pulse****4. To determine the Specific rotation of sugar solution and to determine the sugar concentration of unknown solution****5. to Measure of Doppler frequency and Calculation of the velocity of water flow****6- to measured absorption coefficient in glass and plastic for He-Ne laser,****7. To quantify the effect of distance on the irradiance and beam homogeneity from Quartz-tungsten lamp, LED and laser curing lights at different irradiation distances (2 mm and 9 mm). 2- Improving the Inverse Square Law Experiment When Using the LED Light Source (the power detected within a unit area is inversely proportional to the square of the distance from the light source and illumination with time .****8. To study the diffraction pattern of a circular aperture and finding the diameter of the pinhole****9. Measuring Concentration of Liquids Using a Laser Pointer: Part A: Determine the concentration of a liquid by measuring the solution's index of refraction(tyndall effect)****Part B:1-Measurement of concentration Measurement of absorption coefficient (α).. analyze the effects of light interaction with matter.****10. mechanism of interaction of laser radiation with living things and inanimate matter.****11. safe handling of laser equipment.****12. List the safety aspects and concerns of cutaneous laser systems.** |
| 12- **Student's obligation**Normally, students obliged to attend all the lectures and take notes during the experiment . In addition, in lab participation would be a bonus of the students to widen their knowledge and understand the module thoroughly.During this year the student must be report a patient which treated by laser in hospital and laser center. |
| 13- **Forms Of Teaching**Our laboratory is depend directly on showing the strong point in the experemnt via data show depending on the power point programIn Laser laboratory, the staff members of within the first week will explain the outlines of the lab. and all experiments as well as the regulation and policies to be followed by the student inside the lab. to perform the experiment safely. The lab. as a whole accommodates seven experiments per a week, since each group consists of at least 14 students, then every two student make one experiment altogether in one week. In this manner the student will complete the experiments cyclically in the course. For each performed experiment the student should prepare a scientific report given to the staff in the next week. The student will asks to make at least one seminar relevant to the nuclear laboratory experiments in which all the students will participate in the discussions and evaluations.During this year the student must be report a patient which treated by laser in hospital and laser center . |
| **14- Assessment scheme**All exams have 40 marks, full report has 5 marks(During this year the student must be report a patient which treated by laser in hospital and laser center .10%(every week each student prepared the report about the experiment , quizzes (5%)and 20% final exam: 10%+5%+ 5%+20%==40% |
| 15- **Student Learning Outcome:*** **By the end of the course, students will be expected to be able to…**

**Describe an laser system and physical principles, for each of the types of laser in medicine (co2, pulsed laser … and application in medicine.*** Students who took the module of Laser In Medicine would easily be able to find a job in the Laser department in the Laser centers.
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| 16- **Course Reading list and References:**The main text books are:1. Suzanne Amadorkane , introduction to physics in modern medicine2. Orazio Svelto, David C. “Hanna,Principles of Lasers” Springer New York Dordrecht Heidelberg London, 2010.3. Ronald W. Waynant” LASERS IN MEDICINE”United States of America,2002.4. Markolf H. Niemz”biological and medical physics, biomedical engineering” University of Heidelberg,Springer ,2007 |
| **Lecture's Name** | **17- The Topics** |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.1 :** Spatial Profile of a Laser Beam |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.2 :** Laser pulse Characterization |
| Dr.Amange Francis MSc. Samera Yousif (2 Week) | **Exp.3 :** Measuring Concentration of Liquids Using a Laser Pointer(part A and part b)(2 weeks) |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.4 :** Polarization and Optical Activity |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.5 :** CO2 Laser |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.6 :** measurement the *diameter of hair by laser diffraction* |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.7 :** Laser Doppler Velocimetry (LDV) |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) |

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| **Exp.9 :** Fraunhofer Diffraction |
| from a circular aperture |

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| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.10 :** Photodetectorscharacteristics |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.11 :** ***Gaussian Nature of the Laser Beam & Evaluation of Beam Spot Size***TEM00 ,TEM02 and TEM11 |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.12 :** The Effect of Irradiation Distance on Microhardness of Resin Composites Cured with Light-Emitting Diode |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.13 :** **Study of the Effect of Laser Focuse on the Speed Penetration and Cutting** |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.14 :** *Measuring the Attenuation in Optical fiber* |
| Dr.Amange Francis MSc. Samera Yousif (1 Week) | **Exp.1 5:** Absorption coefficient for **He-Ne laser** |
| **19****Answer all the following questions . (24 Marks)****Q1) ( 3 Marks)**1. How will the diffraction pattern changed when the diameter of the pinhole that produced a Fraunhofer Diffraction pattern is reduced?  **(1 mark)**
2. Find diameter of the pinhole at a known distance of screen from circular aperture of D=500mm. if you know the laser wave length (589 nm) use to diffraction pattern and the radius of the 1st dark ring equal to = 0.35 mm  **(2 marks)**

**Q2) ( 3 Marks)**1. What is Brewster angle ?  **(1 mark)**
2. The polarization angle (Brewster angle) for Quartz by using laser diode is **590 ,** find the refractive index of Quartz . **(2 marks)**

**Q3) ( 3 Marks)**1. What is PRT of pulsed laser output?( Show it by a diagram only) .
2. What is Duty cycle of pulsed laser?( Write the relation only).
3. Define PRR.

**Q4) ( 3 Marks)**Write the name of active medium of the CO2 Laser and Write two application of CO2 Laser in medicine?. **Q5) ( 3 Marks)** In optical resonator experiment, Find beam waist( ωo ) for He-Ne laser (λ=632.8 nm) at Z= 2 m distance and waist (ωZ) as function of propagation distance ( z ) = 0.5cm?.**Q6) ( 3 Marks)** Use the Doppler frequency to find the beam half over lab angle, that the particle velocity Vt =2.23 cm/sec can be measured by determined the Doppler frequency equal l9052 Hz, if the wavelength of laser is 632.8nm.**Q7) ( 3 Marks)**1. Calculate the Responsivity (R) in( A/W) of two photo-detector used for laser diode if you know in first photo-detector Iph= 6 μA and the second photo-detector Iph= 0.5 μA ? if you know the power of laser diode is (20 μW), which photo-detector is best for laser diode? **(2marks)**
2. How can you find the Resptonse time of photo detector used for laser diode in this diagram and Write the equation ?  **(1 mark)**

**Q8) ( 3 Marks)**Calculate the absorption coefficient of glass using the fowing data Draw the total internal reflection of Fiber optics  **(1 mark)**b)...The data in this table (in Exp. Measuring the Attenuation in Optical Fiber Show (graphically) the attenuation as a function of incident angle . **(2marks)**

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| $θ/degree$If you know IL= 20.8 μA IF=34 μ  L=5 m | I/$μ$A |
|  5 | 35 |
| 10 | 32 |
| 15 | 30 |
| 20 | 29 |
| 25 | 27 |

**20. Extra notes:**Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks. | *Fiber* |
| **21. Peer review پێداچوونه‌وه‌ی هاوه‌ڵ** This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*ئه‌م کۆرسبووکه‌ ده‌بێت له‌لایه‌ن هاوه‌ڵێکی ئه‌کادیمیه‌وه‌ سه‌یر بکرێت و ناوه‌ڕۆکی بابه‌ته‌کانی کۆرسه‌که‌ په‌سه‌ند بکات و جه‌ند ووشه‌یه‌ک بنووسێت له‌سه‌ر شیاوی ناوه‌ڕۆکی کۆرسه‌که و واژووی له‌سه‌ر بکات.هاوه‌ڵ ئه‌و که‌سه‌یه‌ که‌ زانیاری هه‌بێت له‌سه‌ر کۆرسه‌که‌ و ده‌بیت پله‌ی زانستی له‌ مامۆستا که‌متر نه‌بێت.‌‌  |  |