



Laser Lab.

**Course Book – (4th Year
Physics– Applied Branch)
Lecturer's name Dr. Amange Francis Boya
Msc. Samira Yousif
Msc.Eman Abid Almajeed
Academic Year: 2021/2022**

Course Book(Lab)

1-Course Name	Laser (lab.)
2-Lab. Staff	Dr. Amange Francis Boya Msc. Samira Yousif <i>Msc.Eman Abid Almajeed</i>
3-Department/ College	E-mail: amange.boya@su.edu.krd Website
4-Contact	Practical: 2
5-Time(In hours) per week	Wednesday 8:30 – 10:30 am, Wednesday 10:30 am – 12:30 pm, Thursday 12:30 – 2:30 pm
6-Office Hours	10 h / week
7- Course Code	n/a
8- Teacher's academic profile	
9- Keywords	N/A
10- Course Overview:	<p>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</p> <p>And Measure of Doppler frequency and determination the velocity of blood</p>

11- Course Objective:

Develop a basic understanding of laser physics concepts and its application in medicine

At the end of the course the student will:

1. Describe the structure and operating principle of laser (semiconductor, gas, and solid-state laser).
2. Describe the 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 calculate 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 the unknown solution
5. To measure Doppler frequency and Calculate the velocity of water flow
- 6- To measure the absorption coefficient in glass and plastic for the 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 find 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 are obliged to attend all the lectures and take notes during the experiment. In addition, lab participation would be a bonus for the students to widen their knowledge and understand the module thoroughly.

During this year the student must report a patient which treated by laser in a hospital and laser center

13- Forms Of Teaching

Our laboratory is depend directly on showing the strong point in the experiment via data shown depending on the PowerPoint program

In the Laser laboratory, the staff members 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. Are to perform the experiment safely. The lab. as a whole accommodates seven experiments per week, since each group consists of at least 14 students, then every two students 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.

16- Course Reading list and References:

The main text books are:

1. Suzanne Amadorkane , introduction to physics in modern medicine
2. 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

17- The Topics

Lecture's Name

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
(1 Week)

Exp.3 : Measuring Concentration of Liquids Using a Laser Pointer(part A and part b)(2 weeks)

Dr.Amange Francis
MSc. Samera Yousif
(2 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)
Exp.9 : Fraunhofer Diffraction from a circular aperture	Dr.Amange Francis MSc. Samera Yousif (1 Week)
Exp.10 : Photo detectors characteristics	Dr.Amange Francis MSc. Samera Yousif (1 Week)
Exp.11 : <i>Gaussian Nature of the Laser Beam & Evaluation of Beam Spot Size</i> TEM00 ,TEM02 and TEM11	Dr.Amange Francis MSc. Samera Yousif (1 Week)
Exp.12 : The Effect of Irradiation Distance on Micro hardness of Resin Composites Cured with Light-Emitting Diode	Dr.Amange Francis MSc. Samera Yousif (1 Week)
Exp.13 : Study of the Effect of Laser Focus on the Speed Penetration and Cutting	Dr.Amange Francis MSc. Samera Yousif (1 Week)
Exp.14 : <i>Measuring the Attenuation in Optical fiber</i>	Dr.Amange Francis MSc. Samera Yousif (1 Week)
Exp.1 5: Absorption coefficient for He-Ne laser	Dr.Amange Francis MSc. Samera Yousif (1 Week)

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Answer all the following questions . (24 Marks)

Q1) (3 Marks)

- a) How will the diffraction pattern changed when the diameter of the pinhole that produced a Fraunhofer Diffraction pattern is reduced? (1 mark)
- b) Find diameter of the pinhole at a known distance of screen from circular aperture of $D=500\text{mm}$. 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)

- a) What is Brewster angle ? (1 mark)
- b) The polarization angle (Brewster angle) for Quartz by using laser diode is 59° , find the refractive index of

Quartz .

(2 marks)

Q3) (3 Marks)

- What is PRT of pulsed laser output?(Show it by a diagram only) .
- What is Duty cycle of pulsed laser?(Write the relation only).
- 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)

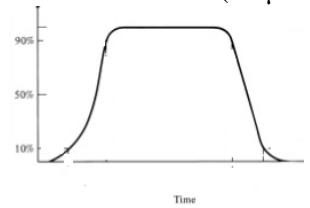
In optical resonator experiment, Find beam waist(ω_0) for He-Ne laser ($\lambda=632.8$ nm) at Z= 2 m distance and waist (ω_z) as function of propagation distance (z) = 0.5cm?.

Q6) (3 Marks)

Use the Doppler frequency to find the beam half over lab angle, that the particle velocity $V_t = 2.23$ cm/sec can be measured by determined the Doppler frequency equal 19052 Hz, if the wavelength of laser is 632.8nm.

Q7) (3 Marks)

- Calculate the Responsivity (R) in(A/W) of two photo-detector used for laser diode if you know in first photo-detector $I_{ph} = 6 \mu A$ and the second photo-detector $I_{ph} = 0.5 \mu A$? if you know the power of laser diode is (20 μW), which photo-detector is best for laser diode? (2marks)
- 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)

- The data in this table (in Exp. Measuring the Attenuation in Optical Fiber Show (graphically) the attenuation as a function of incident angle . (2marks)

$\theta/degree$	$I/\mu A$
5	35
10	32
15	30
20	29
25	27

If you know $I_L = 20.8 \mu A$
 $I_F = 34 \mu$
 $L = 5$ m

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.

21. Peer review

پیداچوونہوہی ھاوہل

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).

ئەم کۆرسبووکە دەبێت لەلایەن ھاوئێکی ئەکادیمیەوہ سەیر بکەیت و ناوڕۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند وشەیک

بنوسنت لهسر شياوى ناوهرۆكى كۆرسهكه و واژووى لهسر بكات.
هاوهل ئهو كهسهيه كه زانبارى ههيبت لهسر كۆرسهكه و دهيبت پلهى زانستى له ماموستا كه متر نهيبت.