Kingdom of Saudi Arabia

The National Commission for Academic Accreditation & Assessment

T5. Course Report (CR)

Course title: Laser in Medicine

Course code: 4033281

Prof. Mohamed M.Sabry
Department of Physics
College of Applied Science
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Course Report

For guidance on the completion of this template refer to the NCAAA handbooks.

Institution: **Umm AL – Qura University**	Date :
College/Department : **College of Applied Science – Department of Physics**	

A Course Identification and General Information

1. Course title **Laser in Medicine** Code **4033281-2** Sections **1**						
2. Name of course instructor **Prof. Mohamed Sabry** Location **Main Campus**						
3. Year and semester to which this report applies. **3rd Year / Level 5**						
. Number of students starting the course? 6 Students completing the course? 6						
5. Course components (actual total contact hours and credits per semester):						
	Lecture	Tutorial	Laboratory/Studio	Practical	Other:	Total
Contact Hours	**30**	0	**0**			**30**
Credit	**2**		0			

B- Course Delivery

1 Topics to be Covered		
Topics	**No of Weeks**	**Contact hours**
Laser Principles 1. Theory of temporal and spatial coherence 2. Coherence Length and Spectral Line Width 3. The optical properties of Laser beam 4. Electromagnetic Modes in a Cavity 5. Theory of Laser Emission 6. Major Types of Lasers 7. Measuring Laser Power and Focusing Laser Energy	**5**	**10**
Optical and Thermal Response of Tissue to Laser Radiation 1. The Optical Response Of Tissue 2. Thermal Response Of Tissue 3. Interaction of Laser Light With Living Systems	**4**	**8**

Therapeutic and Diagnostic Application of Lasers in Ophthalmology 1. Basic Ocular Anatomy and Physiology and Transmission and Absorptive Properties of Ocular Tissues 2. Photothermal Laser Applications 3. Photodisruptive Laser Applications Photochemical Laser Applications: Photoablation and Photodynamic Therapy	**4**	**8**
Laser Safety and classification	**2**	**4**
	15 weeks	**30 hrs**

2. Consequences of Non Coverage of Topics

For any topics where the topic was not taught or practically delivered, comment on how significant you believe the lack of coverage is for the course learning outcomes or for later courses in the program. Suggest possible compensating action.

3. Course learning outcome assessment.

	List course learning outcomes	**List methods of assessment for each LO**	**Summary analysis of assessment results for each LO**
1	Recognize facts, principle and concepts of elementary Physics	a) Quizzes b) Short exams (mid- term exams) c) Long exams (final) d) Homework f) solving problems in class	Passed
2	Describe concepts,		
3	Apply the laws of physics.		
4	Solve problems in Physics by using suitable mathematical principles		
5	Express the physical phenomena mathematically.		
6	Show responsibility for self-learning to be aware with recent developments in physics	a) lab reports b) lab exam c) small group discussion d) problems with open ended answers	Passed
7	Work effectively in groups and exercise leadership when appropriate.		

Summarize any actions you recommend for improving teaching strategies as a result of evaluations in table 3 above.

Usage of flipped classroom and blended learning improve the students skills in addition to their academic progress.

4. Effectiveness of Planned Teaching Strategies for Intended Learning Outcomes set out in the Course Specification. (Refer to planned teaching strategies in Course Specification and description of Domains of Learning Outcomes in the National Qualifications Framework)

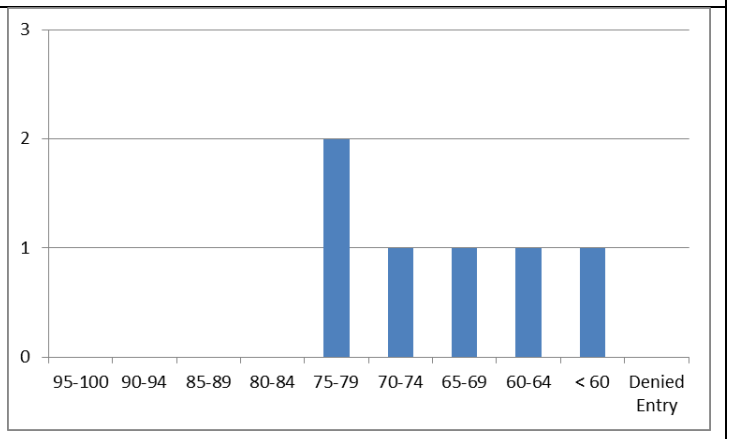
List Teaching Methods set out in Course Specification	Were They Effective?		Difficulties Experienced (if any) in Using the Strategy and Suggested Action to Deal with.
	No	Yes	
• Lectures		√	
• Homework		√	
• Short quizzes		√	
• Two periodic exams		√	
• Final exam		√	
• Presentation		√	
• Small group discussion		√	

C. Results

1. Distribution of Grades

Grade	Number of Students	Student Percentage
95-100	0	
90-94	0	
85-89	0	
80-84	0	
75-79	2	33%
70-74	1	17%
65-69	1	17%
60-64	1	17%
< 60	1	17%
Denied Entry	0	0%
In Progress		
Incomplete		
Pass	5	
Fail	1	
Withdrawn		

Analysis of Distribution of Grades



2. Analyze special factors (if any) affecting the results Students level of English language is very poor.
3. Variations from planned student assessment processes (if any) (see Course Specifications).
a. Variations (if any) from planned assessment schedule (see Course Specifications)
b. Variations (if any) from planned assessment processes in Domains of Learning (see Course Specifications)

4. Student Grade Achievement Verification (eg. cross-check of grade validity by independent evaluator).	
Method(s) of Verification	Conclusion

D Resources and Facilities

1. Difficulties in access to resources or facilities (if any)	2. Consequences of any difficulties experienced for student learning in the course.

E. Administrative Issues

1 Organizational or administrative difficulties encountered (if any)	2. Consequences of any difficulties experienced for student learning in the course.

F Course Evaluation

1 Student evaluation of the course (Attach summary of survey results) Survey Attached
a. List the most important recommendations for improvement and strengths • English as a studying language has to be improved • Labs should be introduced for this course
b. Response of instructor or course team to this evaluation
2. Other Evaluation (eg. by head of department, peer observations, accreditation review, other stakeholders)
a. List the most important recommendations for improvement and strengths
b. Response of instructor or course team to this evaluation

G Planning for Improvement

1. Progress on actions proposed for improving the course in previous course reports (if any).			
Actions recommended from the most recent course report(s)	Actions Taken	Action Results	Action Analysis
a.			
b.			

2. List what other actions have been taken to improve the course (based on previous CR, surveys, independent opinion, or course evaluation).

3. Action Plan for Next Semester/Year				
Actions Recommended for Further Improvement	Intended Action Points (should be measurable)	Start Date	Completion Date	Person Responsible

Name of Course Instructor: _____Mohamed Sabry_____

Signature: _____Mohamed Sabry_____ Date Report Completed: 20/4/1440 H_

Program Coordinator: ___ **Saleh M. Alluqmani** _____

Signature: _ Saleh Date Received: _____

Final Exam

Kingdom of Saudi Arabia
Ministry of Education
Umm Al-Qura University
College of Applied Sciences
Physics Department

Course Name: Laser in Medicine
Course Code: 4033281
Exam Time: 2 Hr(s)
Exam Date: 10 / 4 /1440 H
Number of pages:[1] page

Final Exam

Student's Name: **Student ID:**

Q1: Answer this question أجب على هذ السؤال في ورقة الأسئلة

Choose the correct answer **(20 marks)**

1. Clouding of the lens inside the eye which leads to a decrease in vision.		
a. Cataract	b. Glaucoma	Myopia
2. UV-C is absorbed in . . . . . UV-B is absorbed in . . . . . UV-A is absorbed in in . . . . . Visible is absorbed in. . . . . .IR-A is absorbed in in . . . . . .IR-B is absorbed in in		
a. Cornea	b. Eye lens	Retina
3. Time taken for the target to dissipate about 63% of the incident thermal energy.		
a. Thermal relaxation	b. Extinction length	c. Selective photothermolysis
4. The value of $\sqrt{{n_{core}}^2 - {n_{clad}}^2}$		
a. Relative refractive index	b. Numerical aperture	c. Reflection critical angle
5. Eyewear with OD 3 will reduce the beam power of Laser by a factor of		
a. 3	b. 1000	c. 3000
6. The value $\Gamma_{12} = B_{12}.u(\omega).N_1$ determines		
a. stimulated emission	b. spontaneous emission	c. photon absorption
7. A Q-switch is a device used to .		
a. increase Laser coherence	b. control pulse width	c. make Laser end pumping
8. The equation $g(\omega) = \frac{1}{2\pi}.\frac{\Delta\omega}{(\omega-\omega_0)^2 + (\Delta\omega/2)^2}$ determines		
a. Line shape	b. Thermal equilibrium	c. Light amplification
9. Michelson interferometer is a device that measures		
a. Temporal Coherence	b. Laser power	c. Spatial Coherence
10. An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation hazards		
a. Laser damage	b. Controlled area	c. Nominal ocular distance

Answer Three Questions Only **أجب عن ثلاثة أسئلة فقط**

Q2 **(10 marks)**

In CO_2 Laser,

a. Draw a simple diagram of the device
b. describe the operating principle and draw the energy levels diagram
c. List the wavelengths emitted and applications of the CO_2 Laser

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Q3 **(10 marks)**

A laser pointer with wavelength of 600 nm is let to exit from an aperture with diameter 3mm and produces a 5 mW beam. The beam enters the eye and is focused by a lens whose focal length of 28 mm to a spot on the retina. Find the irradiance on the retina.

Q4 **(10 marks)**

Describe how is Laser used in treating myopia in LASIK surgery.

Q5 **(10 marks)**

Define the following:

a. MPE (Maximum Permissible Exposure)
b. Extinction length

With my best wishes
Dr. Mohamed Sabry

Model Answer to Final Exam

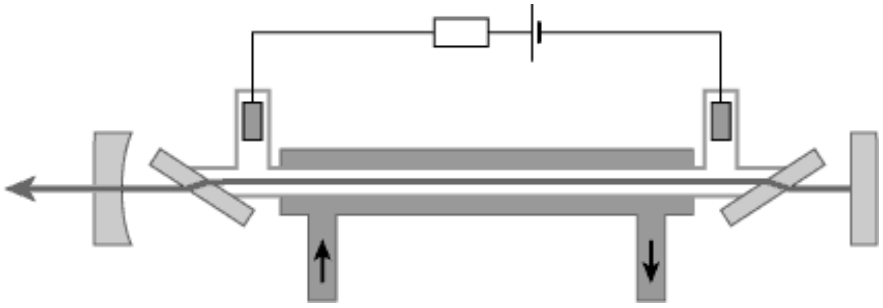
Laser in Medicine Model Answer 4033281
1439-1440 1st Semester

Q1: (20 marks)

1. Clouding of the lens inside the eye which leads to a decrease in vision.		
a. Cataract	b. Glaucoma	Myopia
2. UV-C is absorbed in . **.(a)** . . UV-B is absorbed in . . **(a)** . . UV-A is absorbed in in . . **(b)** Visible is absorbed in. **..(c).** .IR-A is absorbed in **. (c)** .IR-B is absorbed in . . . **(b)** .		
a. Cornea	b. Eye lens	Retina
3. Time taken for the target to dissipate about 63% of the incident thermal energy.		
a. Thermal relaxation	b. Extinction length	c. Selective photothermolysis
4. The value of $\sqrt{{n_{core}}^2 - {n_{clad}}^2}$		
a. Relative refractive index	**b. Numerical aperture**	c. Reflection critical angle
5. Eyewear with OD 3 will reduce the beam power of Laser by a factor of		
a. 3	**b. 1000**	c. 3000
6. The value $\Gamma_{12} = B_{12}.u(\omega).N_1$ determines		
a. stimulated emission	b. spontaneous emission	**c. photon absorption**
7. A Q-switch is a device used to .		
a. increase Laser coherence	**b. control pulse width**	c. make Laser end pumping
8. The equation $g(\omega) = \frac{1}{2\pi}.\frac{\Delta\omega}{(\omega-\omega_0)^2 + (\Delta\omega/2)^2}$ determines		
a. Line shape	a. Thermal equilibrium	b. Light amplification
9. Michelson interferometer is a device that measures		
a. Temporal Coherence	a. Laser power	b. Spatial Coherence
10. An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation hazards		
a. Laser damage	**b. Controlled area**	c. Nominal ocular distance

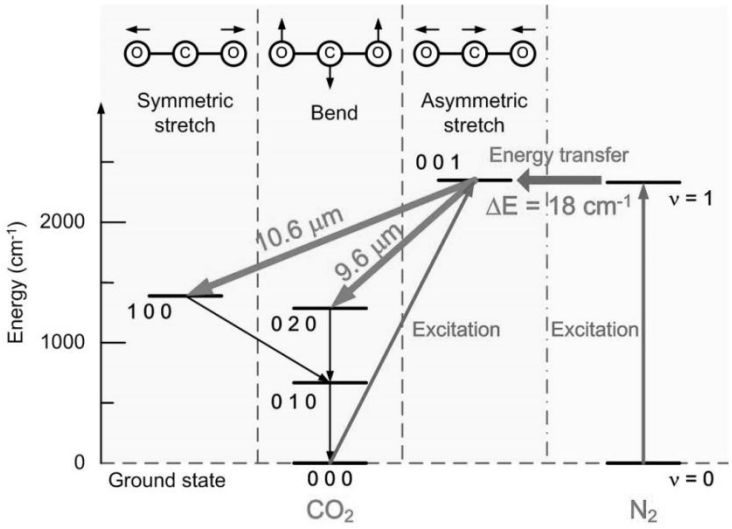
Q2 CO_2 Laser **(10 marks)**

a. simple diagram of the device



b. operating principle and the energy levels diagram

When stimulated by an electric current, nitrogen molecules in the gas mixture become excited. Nitrogen is used because it can hold this excited state for long periods of time without discharging the energy. The high-energy of the nitrogen in turn excite the carbon dioxide molecules by collision. At this point, the laser achieves population inversion. For the laser to produce a beam of light, the CO2 atoms must lose their excited state by releasing energy in the form of photons.



c. wavelengths emitted and applications of the CO2 Laser

Output powers of several watts to several kilowatts can be obtained from CO2 lasers. High-power CO2 lasers find applications in materials processing, welding, hole drilling, cutting, etc., because of their very high output power. In addition, the atmospheric attenuation is low at 10.6 μm which leads to some applications of CO2 lasers in open air communications

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Q3 **(10 marks)**

A laser pointer with wavelength of 600 nm is let to exit from an aperture with diameter 3mm and produces a 5 mW beam. The beam enters the eye and is focused by a lens whose focal length of 28 mm to a spot on the retina. Find the irradiance on the retina.

Diameter of spot $d_0 = \lambda.\frac{f}{d}$ = 600 x 10^{-9} m x 28 x 10^{-3} m / 3 x 10^{-3} m = 5.6 x10^{-6} m

Area of spot: $A = \frac{\pi d^2}{4}$ = 3.14 x (5.6 x10^{-6} m)^2 / 4 = 2.46 x 10^{-11} m^2

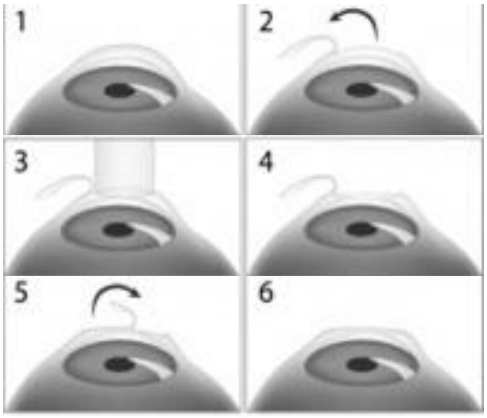
Irradiance: $E = \frac{P}{A}$ = 5 x 10^{-3} W / 2.46 x 10^{-11} m^2 = 2.03 x 10^{8} W/m^2

Q4

(10 marks)

Laser in treating myopia in LASIK surgery.

A surgical instrument is used to cut a flap in the surface of the cornea, which is then folded back rather than removed. An Excimer laser is used to change the shape of the cornea, after which the flap is folded back down to its original position and held in place by natural suction.



Q5

(10 marks)

Define the following:

a. MPE (Maximum Permissible Exposure)

The highest laser energy to which the eye or skin can be exposed for a given laser

b. Extinction length

The thickness of material necessary to absorb 98% of incident energy

Best Mark

Kingdom of Saudi Arabia
Ministry of Education
Umm Al-Qura University
College of Applied Sciences
Physics Department

Course Name: Laser in Medicine
Course Code: 4033281
Exam Time: 2 Hr(s)
Exam Date: 10 / 4 /1440 H
Number of pages:[2] page

Final Exam

Student's Name: إياد القامدي **Student ID:**

Q1: Answer this question

أجب على هذ السؤال في ورقة الأسئلة

Choose the correct answer (20 marks)

1. Clouding of the lens inside the eye which leads to a decrease in vision.		
a. Cataract	b. Glaucoma	c. Myopia
2. UV-C is absorbed in . . . . . UV-B is absorbed in . . . . . UV-A is absorbed in in . . . . . Visible is absorbed in. . . . . IR-A is absorbed in in . . . . . IR-B is absorbed in in		
a. Cornea	b. Eye lens	c. Retina
3. Time taken for the target to dissipate about 63% of the incident thermal energy.		
a. Thermal relaxation	b. Extinction length	c. Selective photothermolysis
4. The value of $\sqrt{{n_{core}}^2 - {n_{clad}}^2}$		
a. Relative refractive index	b. Numerical aperture	c. Reflection critical angle
5. Eyewear with OD 3 will reduce the beam power of Laser by a factor of		
a. 3	b. 1000	c. 3000
6. The value $\Gamma_{12} = B_{12}.u(\omega).N_1$ determines		
a. stimulated emission	b. spontaneous emission	c. photon absorption
7. A Q-switch is a device used to .		
a. increase Laser coherence	b. control pulse width	c. make Laser end pumping
8. The equation $g(\omega) = \frac{1}{2\pi}.\frac{\Delta\omega}{(\omega-\omega_0)^2 + (\Delta\omega/2)^2}$ determines		
a. Line shape	b. Thermal equilibrium	c. Light amplification
9. Michelson interferometer is a device that measures		
a. Temporal Coherence	b. Laser power	c. Spatial Coherence
10. An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation hazards		
a. Laser damage	b. Controlled area	c. Nominal ocular distance

Q2:- يستخدم في:-

1- في العمليات التي تسبب فقدان الدم

2- في العمليات التي اجريت لاشخاص مصابين بعدوى شديدة

3- في عمليات استئصال الاورام اللاوعية الدموية ومرض السرطان

4- في العمليات التي اجريت بالاجهزة.

5- في العمليات التي اجريت بالمناظير او الادوات الجوية.

3

Q3:

diameter = ... = $600 \times 10^{-9} \times 28 \times 10^{-3} / 3 \times 10^{-3}$

$= 5.6 \times 10^{-6}$ ✓

Area of spot = $A = \frac{\pi d^2}{4} = \frac{3.14 (5.6 \times 10^{-6})^2}{4}$ ✓

$= 2.46 \times 10^{-11}$ ✓ (9)

~~$E = \frac{\text{Power}}{\text{Area}} = \frac{5 \times 10^{-3}}{2.46 \times 10}$~~

$E = \frac{\text{area}}{\text{Power}} = \frac{2.46 \times 10^{-11}}{5 \times 10^{-3}} = 4.92 \times 10^{-9}$ ✓

Q4: هي عملية جراحية تستخدم لتصحيح قرب النظر
ويستخدم فيها ليزر Extomic
وهو ان يطوي الطبقة الاولى من القرنية ثم يسلط
الليزر على الانسجة الداخلية من التركيز الكثير من
العدسة ثم يتم ارجاع الطبقة المطوية إلى مكانها الاصلي.

8

Q 5:

1- MPEC (Maximum Permissible Exposure)
هي اعلى طاقة يمكن ان تتعرض لها العين والجلد.

2: Extinction length: Time taken for the target to dissipate about 63% of the incident thermal energy. X

Mid Mark

Kingdom of Saudi Arabia
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College of Applied Sciences
Physics Department

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Course Code: 4033281
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Number of pages:[2] page

Final Exam

Student's Name: osama fahad Al-hatthi **Student ID:** 435039966

12

Q1: Answer this question أجب على هذ السؤال في ورقة الأسئلة

Choose the correct answer **(20 marks)**

1. Clouding of the lens inside the eye which leads to a decrease in vision.		
a. Cataract	b. Glaucoma	Myopia ✓
2. UV-C is absorbed in ..a.. UV-B is absorbed in ..a.. UV-A is absorbed in ..a.. Visible is absorbed in..c.. IR-A is absorbed in in ..a.. IR-B is absorbed in ...b...		
a. Cornea	b. Eye lens	c- Retina
3. Time taken for the target to dissipate about 63% of the incident thermal energy.		
a. Thermal relaxation	b. Extinction length	c. Selective photothermolysis
4. The value of $\sqrt{{n_{core}}^2 - {n_{clad}}^2}$		
a. Relative refractive index	b. Numerical aperture	c. Reflection critical angle
5. Eyewear with OD 3 will reduce the beam power of Laser by a factor of		
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6. The value $\Gamma_{12} = B_{12}.u(\omega).N_1$ determines		
a. stimulated emission	b. spontaneous emission	c. photon absorption
7. A Q-switch is a device used to .		
a. increase Laser coherence	b. control pulse width	c. make Laser end pumping
8. The equation $g(\omega) = \frac{1}{2\pi}.\frac{\Delta\omega}{(\omega-\omega_0)^2 + (\Delta\omega/2)^2}$ determines		
a. Line shape	b. Thermal equilibrium	c. Light amplification
9. Michelson interferometer is a device that measures		
a. Temporal Coherence	b. Laser power	c. Spatial Coherence
10. An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation hazards		
a. Laser damage	b. Controlled area	c. Nominal ocular distance

Q2: CO_2

جهاز مستخدم في الطب يعتمد شعاع الليزر يختص في مجالات معينة أثناء العمليات الجراحية له مزايا عديدة ويوجد منه أجهزة متحركة لنقلها بكل سهولة

1. يستخدم في العمليات الجراحية التي من المتوقع أن يكون بها دم بشكل كبير.
2. يستخدم للمرضى الذين لديهم نزوى شديدة في الأنسجة
3. يستخدم للمرضى الذين لديهم نزيف حاد.
4. يستخدم في العمليات التي يكون فيها الورم متزامن وضرورياً.
5. يستخدم لاستئصال الأورام والأوعية التي يكون بها الريق الخبيث.
6. يستخدم في النظار أو الحبر

Q 3

$\lambda = 600\ nm$ $\quad 600 \times 10^{-9}$ $\quad = 6 \times 10^{-7}\ m$

$\Delta = 3mm$ $\quad 3 \times 10^{-3}$ $\quad = 3 \times 10^{-7}\ m$

$P = 5\ mW$ $\quad 5 \times 10^{-3}$ $\quad = 5 \times 10^{-7}\ m$

$A = 28\ mm$ $\quad 28 \times 10^{-3}$ $\quad = 0.028$

$$E = \frac{P_{(w)}}{A_{(cm^2)}}$$ (3)

$$\frac{5 \times 10^{-3}}{0.028^2} = 0.178$$

$$\frac{5 \times 10^{-3}}{0.028^2} = 6.377\ W/cm^2$$

$$A = \frac{5 \times 10^{-3}}{0.178} = 0.028$$

$$A = \frac{5 \times 10^{-3}}{6.377} = 7.840 \times 10^{-4}\ cm^2$$

$$A = \frac{0.178}{5 \times 10^{-3}} =$$

Q 4

تصحيح النظر يكون بإزالة الطبقة الرقيقة بواسطة آلة بدلاً من التخلص منها ومن ثم نستخدم ليزر EXMire إكسير لتسليط الليزر على القرنية ومن ثم نقوم بإرجاع الطبقة الرقيقة التي تم طيها بواسطة جهاز شفط.

8

Q 5 MPE

أعلى نقطة مضمونة

هي أقصى قدرة للطاقة التي تؤخذ من منطقة العين أو الجلد

3

Worst Mark

Kingdom of Saudi Arabia
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Final Exam

Student's Name: **Student ID:**

Q1: Answer this question

أجب على هذ السؤال في ورقة الأسئلة

Choose the correct answer (20 marks)

1. Clouding of the lens inside the eye which leads to a decrease in vision.

a. Cataract	b. Glaucoma	Myopia

2. UV-C is absorbed in . . . . . UV-B is absorbed in . . . . . UV-A is absorbed in in . . . . . Visible is absorbed in. . . . . .IR-A is absorbed in in . . . . . .IR-B is absorbed in in . . . . . .

a. Cornea	b. Eye lens	Retina

3. Time taken for the target to dissipate about 63% of the incident thermal energy.

a. Thermal relaxation	b. Extinction length	c. Selective photothermolysis

4. The value of $\sqrt{{n_{core}}^2 - {n_{clad}}^2}$

a. Relative refractive index	b. Numerical aperture	c. Reflection critical angle

5. Eyewear with OD 3 will reduce the beam power of Laser by a factor of

a. 3	b. 1000	c. 3000

6. The value $\Gamma_{12} = B_{12}.u(\omega).N_1$ determines

a. stimulated emission	b. spontaneous emission	c. photon absorption

7. A Q-switch is a device used to .

a. increase Laser coherence	b. control pulse width	c. make Laser end pumping

8. The equation $g(\omega) = \frac{1}{2\pi}.\frac{\Delta\omega}{(\omega-\omega_0)^2 + (\Delta\omega/2)^2}$ determines

a. Line shape	b. Thermal equilibrium	c. Light amplification

9. Michelson interferometer is a device that measures

a. Temporal Coherence	b. Laser power	c. Spatial Coherence

10. An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation hazards

a. Laser damage	b. Controlled area	c. Nominal ocular distance

يتم توصيل الليزر الى العين ويتم معالجته عن طريق عملية جراحية بتوصيل الليزر الى بؤبؤة العين بأطوال موجة مختلفة تختلف ما بشخص الى شخص

(2) (4)

$600 \times 10^{-6} \times 30 \times 10^{-3} = 1.8 \times 10^{-8}$ (3)

$\rho = \frac{\pi d^2}{4}$ $3.14 \times 1.8 \times 10^{-8} \div 4$

$= 1.4130 \times 10^{-8}$

$= 14.13 \times 10^{-8} \times 3.53 \times 10^{-7}$ w (5)

1st Periodic Exam

جامعة أم القري
كلية العلوم التطبيقية
قسم الفيزياء

المادة : الليزر في الطب
الفصل الدراسي الأول
1439--1440

اختبار دوري أول

اسم الطالب : **الرقم الجامعي:**

أجب باللغة الانجليزية قدر المستطاع ويسمح باللغة العربية في أضيق الحدود

I. Choose the correct answer **أجب علي هذا السؤال فقط في ورقة الأسئلة** **(4 marks)**

a. The process by which a photon hits an excited atom, and two photons are created.
   (a) Resonator efficiency (b) Stimulated emission
   (c) Spontaneous emission (d) Photon absorption

b. A property characterizes how well a wave can interfere with itself at a different time.
   (a) Temporal coherence (b) Cavity stability
   (c) Population inversion (d) Quality Factor

c. The value $\Gamma_{12} = B_{12}.u(\omega).N_1$ determines
   (a) number of atoms undergoing absorptions per unit time per unit volume
   (b) number of atoms undergoing stimulated emission per unit time per unit volume
   (c) Einstein coefficient

d. When the number of particles in the excited state is greater than the number of particles in the ground state, the material is in a state of
   (a) Coherence (b) Population inversion
   (c) Thermal equilibrium (d) Light amplification

II. Define the temporal coherence, and describe a device by which we can measure temporal coherence of Laser. **(3 marks)**

III. A photon has a wavelength of $5 \times 10^{-7} m$. Calculate its frequency and its energy.
($h = 6.626 \times 10^{-34} Joule\text{-}sec$, $c = 3 \times 10^{8}\ m/s$) **(3 marks)**

IV. List three possible mirror configurations of Laser cavity with drawing. **(3 marks)**

V. Compare between spontaneous and stimulated emissions. **(3 marks)**

1st Periodic Exam

Model Answer

Solution to 1st periodic exam

Q1

a. **(b)** b. **(a)** c. **(a)** d. **(b)**

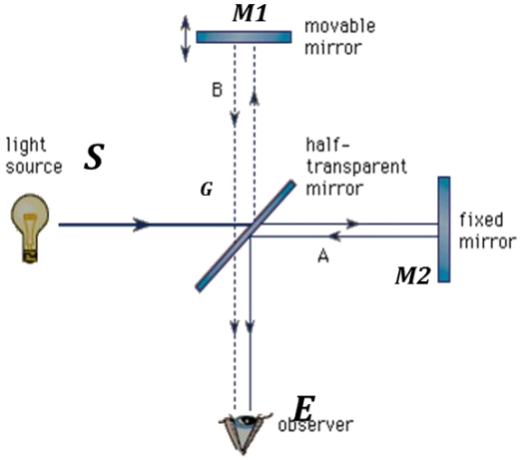
Q2

Temporal Coherence:

Is the measure of the correlation between the wave and itself delayed by τ

Michelson Interferometer

- an extended monochromatic source S,
- G represents a beam splitter, or glass block
- M1 and M2 are two plane mirrors. The mirror M2 is fixed while the mirror M1 can be moved either toward or away from G



Light from the source S is incident on G and is divided into two equal portions; one part travels toward M1 and is reflected back and the other part is reflected back from M2. The two reflected waves interfere and produce interference fringes. When the mirrors M1 and M2 are nearly equidistant from G, i.e, when the two waves traversing the two different paths take the same time, then the contrast of the interference fringes formed is good.

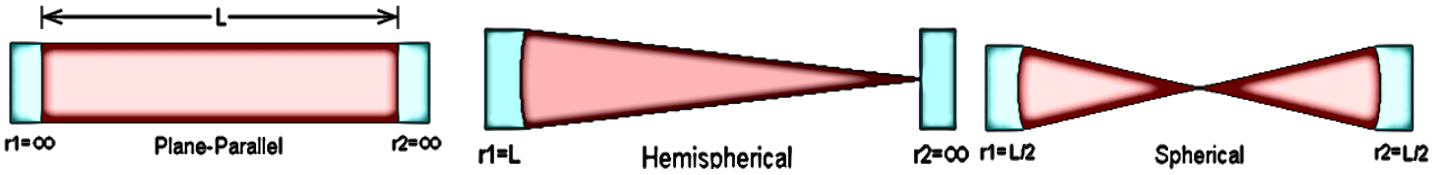
If now the mirror M1 is slowly moved away from G, then it is seen that for ordinary extended source of light (like a sodium lamp), the contrast in the fringes goes on decreasing. Finally, for very large d, past some critical value D, the bright and dark rings have vanished completely, leaving only a diffuse spot of light.

Q3

$$E = h\frac{c}{\lambda} = 6.62 \times 10^{-34} \times \frac{3 \times 10^{8}}{5 \times 10^{-7}} = 3.97 \times 10^{-17}\ joule$$

$$\upsilon = \frac{c}{\lambda} = \frac{3 \times 10^{8}}{5 \times 10^{-7}} = 6 \times 10^{14}\ Hz$$

Q4



Q5

Spontaneous Emission	Stimulated Emission
1. In this process transition occurs from higher energy level to lower energy level.	In this process transition occurs from higher energy level to lower energy level
2. No incident photon is required for transition	Photon whose energy is difference in two energy levels is required
3. Single photon is emitted	In this process two photons of equal energy are emitted
4. In this process emitted light is less amplified.	More amplified
5. Direction of the emitted photons Is random	Direction of the emitted photons is in the direction of incident photon
6. Emitted light is incoherent	Coherent radiation is emitted.
7. This process was postulated by Bohr.	This process was postulated by Einstein.

2nd Periodic Exam

جامعة أم القري
كلية العلوم التطبيقية
قسم الفيزياء

المادة : الليزر في الطب
الفصل الدراسي الأول
1439--1440

اختبار دوري ثاني

اسم الطالب : **الرقم الجامعي:**

أجب باللغة الانجليزية قدر المستطاع ويسمح باللغة العربية في أضيق الحدود

I. Choose the correct answer

أجب علي هذا السؤال فقط في ورقة الأسئلة **(4 marks)**

a. Number of particles in the excited state is greater than number of particles in the ground state.

(a) Population inversion (b) Stimulated emission
(c) Spontaneous emission (d) Photon absorption

b. A Q-switch is a device used to .

(a) increase Laser coherence (b) control pulse width
(c) make Laser end pumping (d) make Laser monochromatic

c. The value $G = R_2 R_1 e^{2(\gamma - \alpha_L)d} \geq 1$ determines

(a) number of atoms undergoing absorptions per unit time per unit volume
(b) number of atoms undergoing stimulated emission per unit time per unit volume
(c) Einstein coefficient
(d) Gain of one complete trip of photon

d. The equation $g(\omega) = \frac{1}{2\pi} \cdot \frac{\Delta\omega}{(\omega - \omega_0)^2 + (\Delta\omega/2)^2}$ determines

(a) Line shape (b) Population inversion
(c) Thermal equilibrium (d) Light amplification

II. Draw a diagram only to show each of the following **(6 marks)**

a. Continuous and pulsed Laser
b. End pumping and side pumping of Laser
c. Three level pumping (and show in the diagram the levels generating Laser)

III. In HeNe Laser, **(5 marks)**

a. Draw a simple diagram of the device
b. describe the operating principle and draw the energy levels diagram
c. List the wavelengths emitted and applications of the HeNe

2nd Periodic Exam

Model Answer

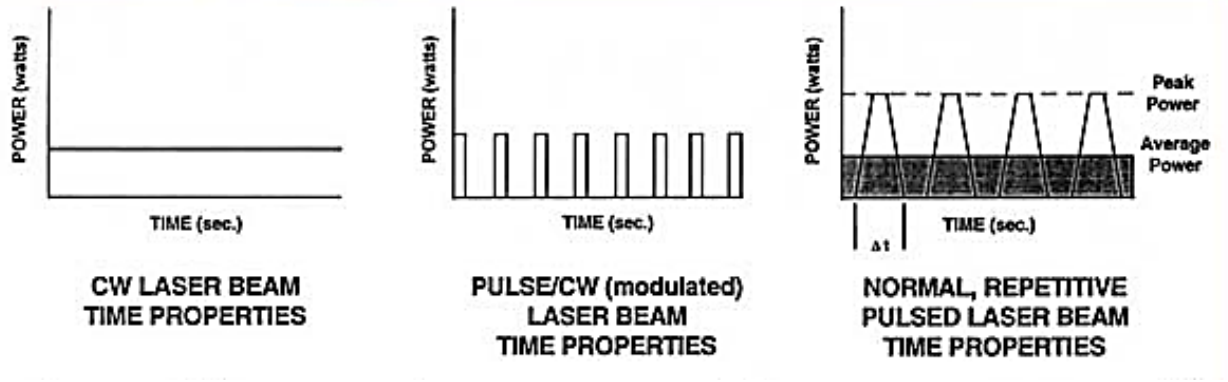
Solution to 2nd Periodic Exam

Q1

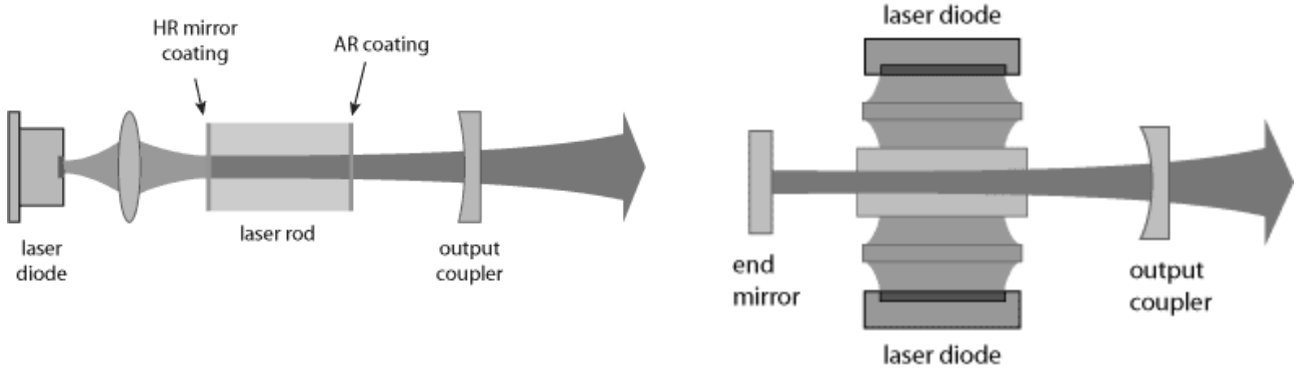
a. (a) b. (b) c. (d) d. (a)

Q2

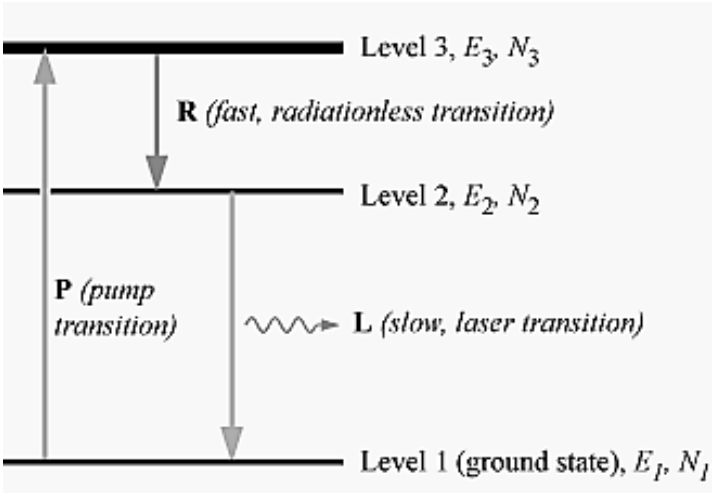
a. Continuous and pulsed Laser



b. End pumping and side pumping of Laser

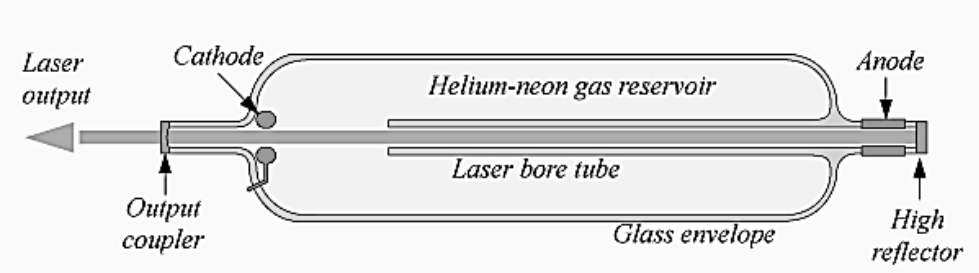


c. Three level pumping



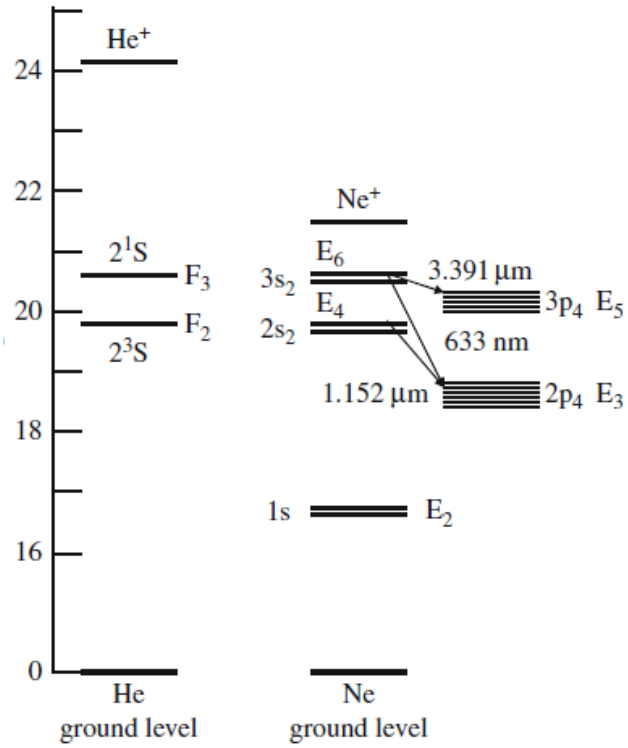
Q3

(a) HeNe diagram



(b)

The gain medium of the laser, is a mixture of helium and neon gases, in approximately a 10:1 ratio, contained at low pressure in a glass envelope. When electrical discharge pass through the gas, electrons accelerates through the tube and collide with helium and neon atoms and excite them to higher energy levels. The helium atoms are excited to levels F2 and F3. Since the levels E4 and E6 of neon atoms have almost the same energy as F2 and F3, excited helium atoms colliding with neon atoms in the ground state can excite the neon atoms to E4 and E6. Since the He atoms are 10 times Ne atoms, then population inversion occurs in the Ne atoms and lasing action happens



(c)

E6 to E5 with wavelength 3.391 µm IR

E6 to E3 with wavelength 633 nm Red

E4 to E3 with wavelength 1.152 µm IR