٤ فيزياء - الليزر وتطبيقاته ف ٤١٠

Mansoura University
Faculty of Science
Physics Department

First term Exam, 27/12/2014
4^{th} level
Time allowed : 2 hours

Full mark : 80 marks

Subject: physics **Course : 410 ف Laser and its applications**

Answer the following questions:

1- a) Sketch schematic diagram of the components of He - Ne gas laser device. By the aid of an energy-level diagram, give the essential feature of this gas laser and some characteristic of its radiation. Explain how population inversion is brought in this system.

(18 marks)

b) Calculate the beam divergence angle (Φ) from the He - Ne laser device which designed with internal beam waist of diameter equal 0.5cm. (He - Ne wavelength is 632.8nm)

(8 marks)

2- a) Drive an expression for the population inversion condition for an atom having three levels. Discuss this condition.

(14 marks)

b) Explain a method to obtain single laser – mode output. Calculate how many modes would oscillate for He - Ne transition (λ =632.8nm) if the spectral width is about 1500MHz and the cavity is 50 cm in the length. ($C = 3\times10^{8}$ m/ sec).

(13 marks)

3- a) Compare between the fundamental difference between photography and holography techniques. Sketch schematic diagram for recording a hologram and reconstructing of the wavefront. Explain, with the aid of schematic diagram, how sandwich holograms interferometric technique measure the distortion of an object.

(14 marks)

b) Evaluate Doppler half width. Calculate the half – maximum line width (Doppler width) for Hg^{198}, where $K=1.38\times10^{-16}$ erg per degree at temperature 300 K and λ= 5460A° ($C=3\times10^{8}$m/sec, Avogadro's number $N_A = 6.022\times10^{23}$).

(13 marks)

With my best wishes
Prof. Dr. Taha Sokkar

ف ٤١٧ إلكترونيات رقمية

Mansoura university Faculty of Science Physics Department		first Term Fourth Year: Physics Date: 30-12-2014 Allowed time: 2 hours
Digital Electronics Exam .	Code : Phys. 417	Full Mark: 80 Marks

Answer The following Questions:

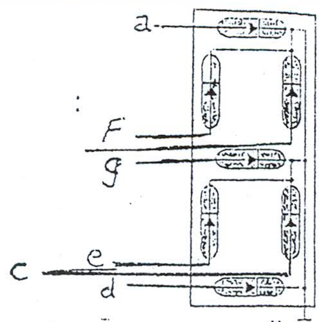

figure (1)

1- Design the logic circuit required to drive the segment d in the 7- segment display shown in figure (1) which used to display numbers from 0 TO 9 using

a) ALL-NAND gates

b) 8 To 1 line data Multiplexer .

2- Design a logic circuit that has three inputs A , B and C . The output of this circuit should be high only when the majority of the inputs are high .Then show how to implement this circuit using

a) ALL- NOR gates .

b) 8 To 1 line data Multiplexer .

3 - a) Convert the follwing numbers to their binary equivalent :
$(48C)_{16}$, $(356.25)_8$, $(35.625)_{10}$.

b) Determine the Q - output in relation to the clock for S-R flip-flop connected as shown in figure (2) .

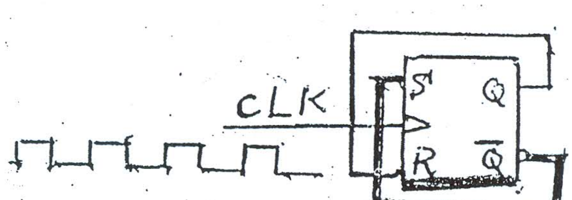

figure (2)

[4] a) Convert the follwing binary numbers to octal and Hexadecimal equivalent : 110101011 , 10110 . 0101

b) Desgine asynchronous decade counter using J-k flip-flops and draw the output waveform of each flip - flop .

٤ فيزياء - طاقة جديدة ومتجددة ف ٤١٨

Mansoura University Faculty of Science Physics Department	Physics Students	First Semester, 2014-2015 Credit hours Students: 4^{th} level January, 2015 (22/01/2015) Time: 2 Hours
Course: Physics (418)	Renewable Energy	Full Mark: 80 Marks

Answer the first question then "Only Two" From The Following:

1-a)	The Sun is considered as the main source of Renewable Energy consists of a body and atmosphere. Discuss this phrase.	*15*
1-b)	Calculate the area of the solar panel needed to give 5 KW, if the sensors in the panel are supplied by energy from silicon photocells of efficiency 30% and the maximum wavelength (λ_{max}) of the energy from the photosphere is .500916 µm k, and if sensors are located at: i- Mercury planet, ii- Earth, iii-Jupiter . $r_{Mercury} = 0.58 \times 10^8$ Km, $r_{Earth} = 1.5 \times 10^8$ Km, $r_{Jupiter} = 7.78 \times 10^8$ Km, $R_{\odot} = 6.96 \times 10^5$ Km, $\sigma = 5.67 \times 10^{-8}$ w m^{-2} k^{-4}, $\alpha = 2897.8$ µm ^{o}k,	*15*
2-a)	If the sun temperature is 5785 ^{o}k, determine the value of the solar constant of the earth. Also determine the characteristic color of the spectra. $h = 6.6252 \times 10^{-34}$ J sec , $k = 1.3806 \times 10^{-23}$ J/ ^{o}k, $R_{\odot} = 6.96 \times 10^8$ m, $C_o = 2.9979 \times 10^8$ m / sec , $\alpha = 2897.8$ µm ^{o}k, $r = 1.5 \times 10^{11}$ m	*15*
2.b)	Define each of the following : i- Photovoltaic phenomena. ii-Incidence monochromatic flux, iii-Transmitted monochromatic flux, iv- Reflected monochromatic flux, v- Absorbed monochromatic flux.	*10*
3.a)	Derive an expression for calculation of the daily extraterrestrial irradiation on a horizontal surface.	*10*
3.b)	Compare between the daily extraterrestrial irradiation on 21 December with that of monthly average daily irradiation for El-Mansoura (31° N), on an inclined surface with angle of inclination = 20°. Consider that $I_{sc} = 1367$ W/m^2.	*15*

4.a)	Prove that the incident angle θ_o for the irradiation over an inclined surface with angle β at latitude ϕ is equivalent to the zenith angle "θ_Z" at latitude **(ϕ-β)**.	*10*
4.b)	Using the given table, determine the percentage of the energy in the spectra of a black body at temperature 5785 °k , for the wavelengths in the following ranges:	*15*

i- 0 – 0.39 *μm.* *ii-* 0.39 – 0.77 *μm.* *iii-* 0.77– 4 *μm.* *iv-* λ > 4 *μm.*

Comment on the results.

x μm *k*	*f*(x)	x μm *k*	*f*(x)	x μm *k*	*f*(x)	x μm *k*	*f*(x)
2200	0.101	4000	0.483	6300	0.762	18000	0.981
2300	0.120	4100	0.499	6400	0.770	19000	0.983
2400	0.140	4200	0.516	6500	0.776	20000	0.986
2500	0.161	4300	0.533	6600	0.783	30000	0.995
2600	0.183	4400	0.549	6700	0.790	40000	0.998
2700	0.205	4500	0.564	6800	0.796	50000	0.999

With My Best Wishes

Examiners:	*Prof. Magdy Tadros (*)*	*Dr. Neven Kamal*

٤ فيزياء - أشباه الموصلات ف ٤١١
فيزياء حيوي

Mansoura University Faculty of science Physics Department		Semiconductor Physics Exam Time: 2 Hours 1st Semester 2014-2015 4th Level

FINAL EXAMINATION

Specialization: Physics & Bio-physics

Full mark: 80 degrees

Answer the questions in Part (A) OR Part (B)

PART (A)

No	Question	Marks
1	**Explain the different kinds of excitation mechanism can cause electron transition from the top of V.B to the bottom of C.B. and what the most type of them?**	10
2	**What is the concept of Effective mass of electron inside the crystal, and drive an mathematical expression of the effective mass?**	10
3	**Illustrate how Kronig-Penny Model use the concept of Band theory of solids to distinguish between conductors, insulators and semiconductors?**	10
4	**For Band-to-Band recombination, define the concept of recombination rate, and drive a mathematical expression for the life time of the excess charge carriers at low and high excitation level .**	10
5	**Analyze the dependence of the life time of non – equilibrium carriers on the concentration of the majority carriers.**	10
6	**Write a definetion of excitons, and discuss its different types.**	10
7	**Compare between:** **a) Frenkle and Mott excitons , and b) Degenarate and non-degenarate semiconductors, c) Direct and indirect transition.**	10
8	**Find the atomic packing factors for the FCC crystal structure.**	10

PART (B)

	No	Question	Marks
1	a	Define the following : i- Intrinsic semiconductors, ii- Extrinsic semiconductors, iii- Drift mobility, iv- Depletion region, v- Hall constant, vi- Depletion layer, vii- Mean free path, viii- Mean free time, viiii- Hot electrons & vv- Avalanch breakdown.	10
	b	Calculate thr resistively of intrinsic specimen of Ge at 300 K if the electron density is $2x10^{19}/m^3$, electron mobility 0.39 and positive hols mobility is $0.19m^2/V.S$ respectively.	5
	c	Deduce the effective mass relation in crystal lattice.	5
	d	Starting with Schrodinger equation to show the energy levels in finite barrier quantum-well formed at p-n junction, showing the condition to be formed.	6
2	a	A crystal of semiconductor has positive hols with density $4.2x10^{15}/cm^3$ and density of states in V.B is $8.6x10^{14}/cm^3$, calculate the position of Fermi energy level at $-4C^o$.	5
	b	Explain how the depletion region behaves like a capacitor.	8
	c	Study Vander Pauw technique to measure Hall constant. How to ensure the quality of the result.	8
	d	Study the transferred electron devices (Gunn diodes).	6
3	a	Study the effect of high field on drift velocity.	5
	b	Study the dependence of the depletion layer in p-n junction diode on both temperature and doping concentrations.	5
	c	Study the factors effect the displacing of Fermi level from the middle of the band gap in an intrinsic semiconductor.	12
	d	Define a p-i-n diode, then deduce, from the space charge distribution, the electrostatic potential at each region.	5

With Best Wishes,

Prof.Dr.N.A.Bakr, Dr. Safaa Abdelmaksoud* and, Prof. Dr. A.Elbedawy*

ف٤١٢ ميكانيكا الكم (٢)

Mansoura University Faculty of Science Physics Department	Level: Four Program: Physics Code: Ph 412	1st Semester Final Exam, 2014-2015 January, 2015 *[2015-01-13]* Time: 2 Hours

Quantum Mechanics II

Answer ALL of the Following Questions: *(Total mark: 80 marks)*

1.a)	For spin corresponding to $s = 1/2$, what are the eigenvectors of $\hat{S}_x$, $\hat{S}_y$ and $\hat{S}_z$?	*10*
b)	Explain mathematically, how can Stern-Gerlach experiment determine the spin of a particle?	*10*
2.	A nuclear particle of spin ½ initially in spin state $\alpha_z = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ has spin motion only immersed in a magnetic field has the form $\underline{B}(t) = B_0[\cos(\omega t)\hat{\underline{i}} - \sin(\omega t)\hat{\underline{j}}] + B_z\hat{\underline{k}}$, where B_0, ω and B_z are constants. Find the resonance frequency of this system.	*20*
3.a)	A system in an initial state ℓ of unperturbed Hamiltonian $\hat{H}_0(\underline{r})$ affected by a perturbed Hamiltonian $\hat{H}_1(\underline{r},t) = G(\underline{r})f(t)$. What is the probability after time (t) of the transition to another state k of $\hat{H}_0(\underline{r})$?	*10*
b)	Consider the above system is an atom at its stationary state $\psi_\ell(\underline{r},t)$ interacts with a weak electromagnetic field of perturbed Hamiltonian $H_1(\underline{r},t) = 2H'(\underline{r})\cos(\omega_0 t)$ of constant frequency (ω_0). What is the transition probability of this atom to be excited to another energy state $\psi_k(\underline{r},t)$ at time (t)?	*10*
4.a)	A particle of mass (m) and wave number (k) moves in the z-direction is scattered at a scattering center has radial potential $V(r)$. Using Born approximation, find the scattering amplitude.	*10*
b)	Calculate the differential scattering cross-section of the particle in part (a) if the scattering potential is the attractive Gaussian potential $V(r) = -V_0 \exp(-r^2/a^2)$, where the height ($V_0$) and the width ($a$) are constants. [Hint: use $\int_0^\infty dx\, x \sin(\alpha x) e^{-\beta x^2} = \frac{1}{4}\sqrt{\frac{\pi\alpha^2}{\beta^3}} \exp(-\frac{\alpha^2}{4\beta})$]	*10*

With our Best Regards

Examiners:	*Prof. Essam M. Abulwafa (*)*	*Prof. Gommaa El-Damrawy*

٤ فيزيا - الكتروديناميكا ف (٤١٣)

Mansoura University Faculty of Science Physics Department **Subject : Physics**	Forth Year Physics	**First Term** **Forth Year : Physics** **Date 1o/1/ 2015** **Time allowed : 2 hours**

Electrodynamics (2) ph (413)

Answer the following questions

[1] a - Unpolarized plane electromagnetic wave is incident obliquely on the interface between two dielectric media with refractive indices n_1 & n_2 respectively and $\mu_1 = \mu_2$. Find the amplitude coefficient $(E_{0r}/E_{0i})_{//}$ and show that at Brewster's angle, the reflected wave is linearly polarized perpendicular to the plane of incidence. (25)

b - A uniform plane electromagnetic wave in free space whose electric field is given by $\vec{E} = 10\, e^{i\,(6\pi x - \omega t)}\hat{e}_z$ is incident normal to the surface of a material having $\varepsilon = 4\varepsilon_0$, $\mu = \mu_0$ & $\sigma = 0$. Obtain the corresponding expressions for the reflected electric and magnetic fields .

[2] a - Obtain an expression for the conductivity of a metal subjected to an electromagnetic field. (25)

b - A plane electromagnetic wave travels through a uniform plasma . Show that the average energy flux $\langle \vec{S} \rangle$ vanishes if the frequency of the wave is less than the plasma frequency.(**Note** : the propagation constant for a conducting medium is given by $k^2 = \mu\varepsilon\omega^2 \left[1 + i\,\frac{\sigma}{\omega\varepsilon}\right]$).

[3] The electromagnetic field vectors inside a wave guide are given by $\vec{E}(\vec{r};t) = \vec{E}_0(x,y)e^{i(k_g z - \omega t)}$ and $\vec{H}(\vec{r};t) = \vec{H}_0(x,y)e^{i(k_g z - \omega t)}$. Show that the transverse components of a guided wave are given in terms of the longitudinal components $E_{0z}(x,y)$ and $H_{0z}(x,y)$, and transverse electromagnetic waves can't propagate inside a hollow conductor. Rewrite the obtained equations for TE wave. (20)

[4] a - In case of normal incidence on the interface between region 1 with $\varepsilon = 8\varepsilon_0$, $\mu_1 = \mu_0$ & $\sigma_1 = 0$ while region 2 is free space, compute the reflection coefficient R , the transmission coefficient T, the critical angle and Brewster angle. (10)

(Constants may be needed: $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m , $\mu_0 = 4\pi \times 10^{-7}$ H/s)

With best wishes

أ.د/ هيام مشالي