ع فيزياء - الليزر وتطبيقاته ف ٤١٠

Mansoura University Faculty of Science Physics Department		**First Term. 2014** **4th level** **Date :29-12- 2013** Time allowed : **2 hours** Full Mark: **80 Mark**
Subject: **Physics**		Course: **Laser and its application 410 ف**

Answer the Following Questions

[1] a- Describe the essential feature of a He -Ne laser and some characteristics of its radiation. Explain by the aid of an energy-level diagram, how population inversion is brought about in such gaseous system. **[16 Marks]**

b- At what temperature the rates of spontaneous and stimulated emission are equal (λ= 500 nm)?
Not: $h=6.625\times10^{-34}$ J. sec, $K=1.38\times10^{-23}$ J /K. $C=3\times10^{8}$ m/sec. **[10 Marks]**

[2] a-Discuss the coherence of laser sources. If you are given a tungsten lamp, explain how you can improve its temporal and spatial coherence. **[9 Marks]**

b- If the kinetic theory in case of broadening due to thermal motion gives the fraction of atoms $\frac{\delta N}{N}$ where component of velocity lies between V_x and $V_x + \Delta V_x$ as:

$$\frac{\delta N}{N} = \sqrt{\frac{M}{2\pi KT}}\, e^{-\left(\frac{mV_x^2}{2KT}\right)} \Delta V_x \quad ,$$

derive an expression for the gain of a laser beam in a medium enjoying population inversion taking into consideration Doppler broadening. **[9 Marks]**

c- If the He -Ne laser device is designed with internal beam waist of diameter equal 0.5 mm and its wavelength of 632.8 nm, calculate the beam divergence angle (ϕ). **[9 Marks]**

[3] a- Describe and explain the population inversion for an atom having four-levels. Drive an expression for the population inversion condition. **[18 Marks]**

b- Sketch schematic diagram for recording a hologram and reconstructing of the wavefront. **[9 Marks]**

Good Luck

Examiner: Prof. Dr. Taha Sakkar

المستوى الرابع - الفيزياء - جسيمات أولية ف ٤١٦

Mansoura University Faculty of Science Physics Department	Year: 4th Level Specialization: *Physics Program*	First Semester Dec., 2013 Time: 2 Hours

Subject: *Elementary Physics* *Wednesday 25/12/2013* *12-02 PM*

(جسيمات أولية- ف 416)

Answer The Following Questions: (Full mark: 80)		*Mark*
1.a)	Make a brief classification of the elementary particles, then give a quark description of: Σ^+, Σ^0, Σ^-, Ξ^0, Ξ^-, Λ, Ω^-.	*8*
1.b)	Put the charge (Q) & strangeness (S) values for the *spin* ½ octet (8)-baryons in a table, then draw the hexagonal 8-fold way pattern for these values, [using horizontal axis for (S) & sloping axis for (Q)].	*12*
2.a)	Write a brief account about the standard model & the 3 generations of matter.	*8*
2.b)	Show how the decay of a kaon (K^+) into three pions (2 π+, 1 π–) is a process that involves both weak and strong interactions	*12*
3.a)	How many (color)-quantum numbers of quarks & anti-quarks? And then mention all the possible combinations for gluons using these colors	*9*
3.b)	Show how by introducing the new quantum number (color), the problem of existing 3 strange quarks (sss) in the omega-minus (Ω^-) particle can be solved?	*11*
4.a)	Write briefly on the 4 forces in nature and their gluons (mediating particles).	*8*
4.b)	Show how when a very high enough energy gamma ray is scattered from a neutron, an anti-quark-quark pair is created (for example, u & $\bar{u}$), and a pion (π) and proton (p) are the final particles.	*12*

With our Best wishes

Examiners:	*Prof. Dr Ali H. El-Farrash**	*Prof. Dr Ahmad El-Garayhy*

* *Corresponding Examiner*

المستوى الرابع - فيزياء - الكتروديناميكا (٥) ف ٤١٣

Mansoura University Faculty of Science Physics Department Subject : Physics	Fourth Year Physics	First Term :2013-2014 Fourth Year : Physics Date : 1/1/ 2014 Time allowed : 2 hours

Electrodynamics(2) phys. (413)

Answer the following questions

(1) a - Obtain an expression for the amplitude reflection coefficient (r_p) for a plane electromagnetic wave which is incident obliquely upon the boundary between two dielectric media . (20)

b - If the second medium in part (a) is replaced by a perfect conductor and the electric field near its surface is $E_x = 2E_0 \sin(kz) \sin(\omega t)$, compute the average energy flux and physically comment on the result .

(2) a - Show that , in a hollow conductor the transverse components of the electromagnetic field vectors are obtained in terms of the longitudinal one and a TEM mode cannot be propagating in the hollow conductor. (20)

b - A TE wave propagates in an air filled rectangular waveguide with sectional dimensions a and b. If $H_{0z} = H_0 \cos\left(\frac{m\pi x}{a}\right) \cos\left(\frac{n\pi y}{b}\right)$. Obtain expressions for E_{0x}, E_{0y}, H_{0x} and H_{0y} and calculate the cutoff frequency for the lowest mode when a = 8 cm and b = 4 cm .

(3) a - The Lorentz gauge for the electromagnetic field requires that $\vec{\nabla}.\vec{A} = -\varepsilon\mu \frac{\partial \phi}{\partial t}$, (20)
find the differential equations satisfied by the vector potential $\vec{A}$ and the scalar potential ϕ .

b – Answer **only one** item from the following :

(i) Find Liénard- Wiechert potentials produced by a point charge q moving with arbitrary velocity $\vec{u}$.

(ii) Show that plane electromagnetic waves can't propagate through a tenuous plasma if its frequency is less than the plasma frequency .

Good luck
Hayam mashaly

Mansoura University Faculty of Science Physics Department	Level: Four Program: Physics Code: Ph 412	First Semester Final Exam, 2013-2014 January, 2014 *[2014-01-05]* Time: 2 Hours

Quantum Mechanics II

Answer ALL of the Following Questions:

(Total mark: 80 marks)

1.a)	Show that: it is impossible for a spin-½ particle to be in a state $\begin{pmatrix} a \\ b \end{pmatrix}$ such that $< S_x >=< S_y >=< S_z >= 0$.	*10*
b)	Explain how the Stern-Gerlach experiment can be used to find the spin of a particle.	*10*
2.a)	A spinning, fixed electron initially in the spin state $\alpha_x = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ affected with a constant uniform magnetic field in the z-direction has intensity B_0. Calculate the electron eigen-function at time (t).	*8*
b)	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 $\underline{B}(t) = B_0[\cos(\omega t)\hat{\underline{i}} - \sin(\omega t)\hat{\underline{j}}] + B_z\hat{\underline{k}}$. Find the resonance frequency of this system.	*12*
3.a)	Find the transition probability of a particle in initial state to another state of unperturbed Hamilitonian (H_0) due to the effect of factorable time-dependent perturbed part (H') added, after time (t).	*10*
b)	Using the transition probability rate for radiation absorption as: $\frac{2\pi}{\hbar}\left\| < \ell \middle\| H'(\underline{r}) \middle\| k > \right\|^2 \delta(\omega_{k\ell} - \omega)$, make Einstein's derivation of Planck's radiation formula.	*10*
4.a)	Prove that: the differential scattering cross-section $d\sigma/d\Omega$ is equal to the square of the absolute value of the scattering amplitude $f(\theta,\phi)$.	*10*
b)	Derive the transition probability rate for a particle of mass (m) in initial state (k) to a final state (k') in an energy band of energy states density $[g(E_{k'})]$. $[\int_{-\infty}^{\infty} dx \sin^2(x)/x^2 = \pi]$.	*10*

With our Best Regards

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

Mansoura University **Faculty of Science** **Physics Department** **Course Title: Semiconductor** **Date: 12/1/2014**		**Jan. 2014** **Exam Type: Final** **Four Level: (physics)** **Time: 2 Hours** **Full Mark: 80 Mark**

Answer **the following questions:-**

Q1: [25 Mark]

a- What is a semiconductor?

b- Discuss the semiconductor applications

c- How do semiconductors work?

Q2:- [25 Mark]

a- How to made semiconductor?

b- Discuss the importance the importance of semiconductor?

c- Explain the types of semiconductor

Q3:- [30 Mark]

Write with details on:-

a) Photoconductivity

b) Oorganic semiconductor

c) Luminescence

With best wishes

Examiners

أ.د. أبوبكر البديوى **د. أنور مجاهد**

المستوى الرابع - فيزياء - فيزياء رياضيات (٣) ف ٤١٤

Mansoura University Faculty of Science *Physics Department* **Final Exam – 1st Term** (15 Jan. 2014)	**2013-2014**	**Fourth Year Students** **(Special Physics)** **Course: Math. Physics 3 (Phy414)** **Time allowed: 2 hours**

Answer the following questions **Full Mark: 80** (Every question: 20 Mark)

Q1:

A) Prove Cauchy-Riemann equations for the analytic functions. And show if $f(z)=z^2e^{-iz}$ is analytic function or not, where $z = x + iy$.

B) Are the following functions harmonic? If answer is yes, find the corresponding analytic function

1) $u=3x^2y+2x^2-y^3-2y^2$ **2)** $u=2xy+3xy^2-2y^3$

Q2:

A) Evaluate the following integrals:

(i) $\oint_C \frac{z^4-8}{2z-i}dz$, (ii) $\int_{-\pi i}^{\pi i}\cos z\,dz$, (iii) $\oint_C \frac{e^z}{\left(z^2+\pi^2\right)^2}dz$ where z is a complex variable.

B) Using the parametric representation calculate the integral of $\frac{1}{z}$ around a circle of radius ρ and centered at the origin of the complex plane.

Q3:

A) Find the resolvent kernel for the kernel $K(x,t)=\exp(x+t)$ and solve the integral equation:

$$\phi(x)=x+\lambda\int_0^1 K(x,t)\phi(t)dt$$

B) Using the Fredholm determinates, construct the resolvent kernel for the kernel:

$$K(x,t)=x\exp(t) \quad \text{for the interval } [a,b]=[0,1]$$

Q4:

A) Define the degenerate kernel and solve the integral equation:

$$\phi(x)-\lambda\int_{-\pi}^{\pi}\left[x\cos t+t^2\sin x+\cos x\sin t\right]\phi(t)dt=x$$

Answer ONLY ONE from the following:

B) Find the eigenvalues and eigenfunctions of the homogenous integral equation

$$\phi(x)=\lambda\int_0^{\pi}\cos(x+t)\phi(t)dt$$

C) Define the symmetric kernel, and solve the homogeneous integral equation for the kernel:

$$K(x,t)=\begin{cases}x(t-1) & 0\le x\le t\\ t(x-1) & t\le x\le 1\end{cases}$$

With our best regards

Prof. Dr. S. A. El-Wakil & Dr. M. Sallah

المستوى الرابع - فيزياء - إلكترونيات رقمية ف ٤١٧ .

Mansoura University
Faculty of Science
Physics Department

First semester
Date: 22/1/2014

Level 4 . physics Students
Full Mark: 80
Allowed time: 2 hours
Course title: Digital Electronics
Course Code : Phys 417

Answer The Following Questions

1-a) 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 .

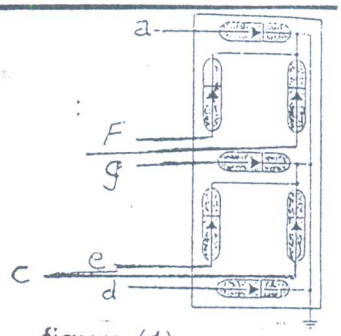

figure (1)

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

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-NAND gates

b) 8 To 1 line data Multiplexer .

3-a) Design the logic circuit of a full adder, then draw how to connect a half-adder and three full-adders to form a four- bit parallel adder.

b) Convert the follwing binary numbers to octal and Hexadecimal equivalent : 101010100110 , 10110 . 010101

4- a) a) Draw the comparator logic circuit which used to compare Two 3 -bit s binary numbers P , Q

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

المستوى الرابع - فيزياء - الطاقة الجديدة والمتجددة ف ٤١٨

Mansoura University Faculty of Science Physics Department	Physics Students	First Semester, 2012-2013 Credit hours Students: 4th level January, 2014 (22/01/2014) 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)	Prove that the incident angle θ_0 for the irradiation over an inclined surface with angle β at latitude ϕ is equivalent to the zenith angle "θ_Z" at latitude $(\phi-\beta)$.	15
2-a)	If the characteristic wave length of the spectra from sun is 0.5009161 μm, i-Calculate Stephan Boltzmann constant, and determine the percentage of error from the experimental value $\sigma = 5.6866\times10^{-8}$ $Wm^{-2}K^{-4}$. ii- Determine the temperature of the photosphere. iii- Using the calculated value determine the value of the solar constant of the earth. $h = 6.6252 \times 10^{-34}$ 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- ii-Incidence monochromatic flux, iii-Transmitted monochromatic flux, iv-Monochromatic reflectance coefficient , v- Monochromatic transmittance coefficient.	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 22 March 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) The spectra from the photosphere is divided into different regions, discuss this phrase with drawing the corresponding sketch, illustrating each region on the sketch. *10*

4.b) Using the given table, determine the percentage of the energy in the spectra of a black body at temperature 5785 ^{o}k , for the wavelengths in the following ranges:

i- 0 – 0.39 μm. *ii*- 0.39 – 0.7μm. *iii*- 0.7– 4 μm. *iv*- $\lambda > 4$ μm.

Comment on the results. *15*

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	19000	0.983
2300	0.120	4100	0.499	6400	0.770	20000	0.986
2400	0.140	4200	0.516	6500	0.776	30000	0.995

With My Best Wishes

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