Mansoura University | **First term Exam, 2 /1/2016**

Faculty of Science | **4th level**

Physics Department | **Time allowed : 2 hours**

Full mark: 80 marks

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

Answer the following questions:

1- a) Sketch and explain schematic diagram of the components of Carbon dioxide laser device. Describe the essential feature of this Co_2 laser and its fundamental vibration configurations. Explain by the aid of an energy level diagram, how population inversion is brought.

(20 marks)

b) Explain how an assembly of randomly oriented optical fibers can be used in the field of cryptography for coding and decoding optical information.

(7 marks)

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

(15 marks)

b) Explain the principles of sandwich holograms and illustrates how the deformation of an object may be determined.

(6 marks)

c) A He-Ne laser emits light with wavelength 633nm in a transition between two states of Neon atoms. What would be the ratio of population of the upper state relative to the lower state of Neon atom if they were in thermal equilibrium at 300k ? (Note: $h=6.625\times10^{-34}$j.sec, $K=1.38\times10^{-23}$j/k, $C=3\times10^{8}$m/sec).

(6 marks)

3- a) Drive an expression for the growth of a laser beam in a medium.

(10 marks)

b) Discuss that, directionality is the optical property of light distinguish the laser from other light source.

(8 marks)

c) Demonstrate and explain an experimental arrangement for observing the longitudinal mode characteristics of a laser source.

(8 marks)

With my best wishes

Prof. Dr. Taha Sokkar

Mansoura University Faculty of Science Physics Department	4th Level Physics	1st Semester, 2015-2016 January, 2016 *[2015/01/05]* Time: 2 Hours

Phys 414: Mathematical Physics (III)

Answer All the following Questions:	*(Full mark: 80)*	*Mark*
1.	Solve the integral equation: $\phi(x) - \lambda\int_{-\pi}^{\pi} dt[x\cos(t) + t^2\sin(x) + \cos(x)\sin(t)]\phi(t) = x$.	*14*
2.	Find the eigen-values and eigen-functions of the homogeneous integral equation: $\phi(x) = \lambda\int_0^{\pi} dt\cos(x+t)\phi(t)$.	*16*
3.	Find the solution of the integral equation: $\phi(x) = \exp(x) - \int_0^x dt\exp(x-t)\phi(t)$.	*14*
4.	Find the Laurent series for: $\exp(2z)/(z-1)^3$, at $z=1$.	*16*
5.a)	Evaluate the integral: $\int_C dz\cosh(\pi z)/[z(z^2+1)]$, where C is the circle $\|z\| = 2$.	*10*
b)	Show that: $f(z) = \exp(x)[\cos(y) + i\sin(y)]$ is analytical and then find $f'(z)$.	*10*

With our Best Wishes

Examiners:	*Prof. S. A. El-Wakil (*)*	*Prof. A.-R. Degheidy*

Mansoura University Faculty of Science Physics Department Subject : Physics	Forth Year Physics	First Term Forth Year : Physics Date 9 /1/ 2016 Time allowed : 2 hours

Electrodynamics (2) ph (413)

Answer the following questions

[1] a - A plane electromagnetic wave is incident obliquely on the interface between two perfect nonmagnetic dielectric media with refractive indices n_1 & n_2 respectively. If the electric field vectors are polarized parallel to the plane of incidence find the reflection amplitude coefficient , r_p. (25)

b - Unpolarized plane electromagnetic wave propagates from a dielectric ($k_e = 8.54$, $k_m = 1$) to the interface with free space at an angle of incidence equals 18.89^0. Prove that the reflected wave is linearly polarized perpendicular to the plane of incidence and calculate the critical angle.

[2] a - Derive the expressions for the components of the electromagnetic field vectors Propagating inside a hollow conductor. Comment on the obtained equations. (25)

b – An air-filled wave guide of dimensions a &b with its axis lies along z direction. Given $E_{0z}=E_0\sin(m\pi x/a)\sin(n\pi y/b)$, what type of this mode of Vibration?. Find the expressions of the field vectors for the lowest frequency mode.

[3] a - A plane electromagnetic wave traveling in a dielectric medium is incident normal to the surface of a conductor . Find the reflection coefficient , R , and show that in the case of a perfect conductor the field in the dielectric behaves as a standing wave. (25)

b - In part (a) assume the dielectric medium is free space, the conductor is perfect and the total electric field is zero at a distance 1m away from the surface of the perfect conductor, then find the frequency of the incident wave.

[4] Answer **only one part** (a or b)

a – A linearly polarized plane electromagnetic wave propagates in the upper layer of the atmosphere at the direction of the earth horizontal component . Show that the wave splits into two circularly polarized waves with different refractive indices.

b – Write the expressions of the retarded potentials $\phi(\vec{r},t)$ & $\vec{A}(\vec{r},t)$ .Find the potential $\phi(\vec{r},t)$ produced by a point charge in an arbitrary motion.

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

With best wishes

أ.د/ هيام مشالي

Mansoura University
Faculty of Science
Physics Department

First term Exam. : Jan. 2016

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) Convert the follwing numbers to their binary equivalent : $(4\ AC)_{16}$, $(4\ 36.25)_8$,$(46.375)_{10}$; and Convert the follwing binary numbers to octal and Hexadecimal equivalent : 10110.101 , 10010 . 01101

b) Design a logic circuit that has four inputs A ,B ,C and D . The output of this circuit should be high only when at least two of the inputs are high .Then show how to implement this circuit using ALL- NOR gates .

2-a) Using ALL- NAND gates , design the logic circuit required to drive the segment d in the 7- segment display shown in figure (1) which can be used to display numbers from 0 TO 9 .

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

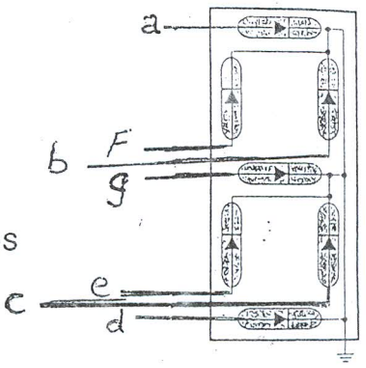
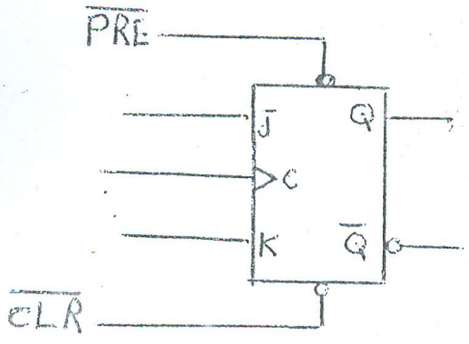


figure (1)

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) in figure (2) . determine the Q-waveform if the signals shown are applied to the inputs of the J-k flip-flop.Assume that Q is initially Low



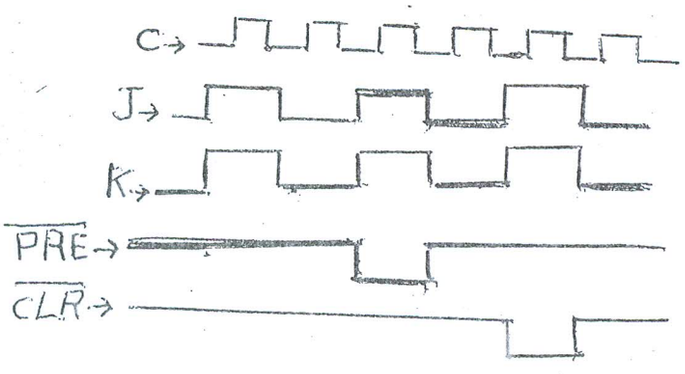


figure (2)

4- a) Determine the Q - output in relation to the clock for S-R flip-flop connected as shown in figure (3) .

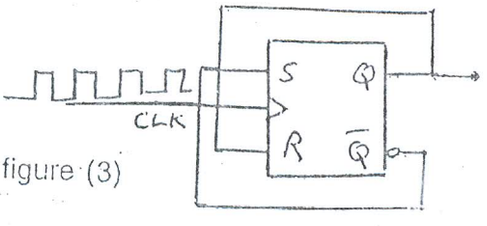


figure (3)

b) Draw the comparator logic circuit which used to compare Two 3 -bits binary numbers P , Q

Mansoura University Faculty of Science Physics Department	Physics, 4th Level	First Term, 2015-2016 January, 2016 Time: 2 hours.

Semiconductors (Ph. 411)

Full Mark: 80 Marks

Answer the following Questions:

1. a)	Study the dependence of the mobility on the effective mass fore both charge carriers.	10 Marks
b)	Starting with the space charge distribution, deduce the electric field at each region at p-i-n diode.	10 Marks
c)	A silicon crystal has donor density $1.6\times10^{17}/cm^3$. The donor level lies at energy= 0.45eV, calculate the position of Fermi level and carrier concentration at room temperature, if the density of state at conduction band $=8.8\times10^{14}\ T^{3/2}\ /m^3$.	10 Marks
2. a)	Discuss the dependence of the Depletion layer in p-n junction diode on both temperature and doping concentrations.	10 Marks
b)	Study the factors effect the displacing of Fermi level from the middle of the band gap in an extrinsic semiconductor	10 Marks
3. a)	Show how the diffusivity and mobility are related through the Einstein relations.	10 Marks
b)	Discuss the effect of high field on drift velocity.	10 Marks
c)	Define the following: i-Conduction Band, ii –Donor Level, iii-Effective Mass, iv-Fermi Level, v- Hot electrons, vi-Avalanche breakdown, vii-p-n junction, viii-Valence Band, viv-Zincblende& vv-Electron-Hole Pair .	10 Marks

With our best wishes,

Dr. Safaa Abdel-Maksoud & Prof. Dr.A.Oraby

Mansoura University Faculty of Science Physics Department	Level: Four Program: Physics Code: Ph 412	First Semester Final Exam, 2015-2016 January, 2016 *[2016-01-23]* Time: 2 Hours

Quantum Mechanics (II)

Answer ALL of the Following Questions:

(Total mark: 80 marks)

1.a)	Consider the problem of a spinning but otherwise fixed electron in a constant uniform magnetic field of intensity B_0 that points in the z-direction. Calculate the eigen-states and eigen-energies of this same system.	*10*
b)	Consider that a polarized beam containing electrons in the α_z state is sent through a Stern-Gerlach analyzer which measures S_x. What are probabilities to find the values $S_x = +\eta/2$ or $S_x = -\eta/2$?	*10*
2.	Using the classical Rayleigh-Jeans law of black-body spectrum $u_{RJ}(\nu) = \frac{8\pi\nu^2}{c^3} k_B T$, where ν is the frequency, c is the velocity of light, k_B is Boltzmann constant and T is the absolute temperature and the transition probability rate for radiation absorption $\frac{2\pi}{\eta} \lvert < \lambda \lvert H'(\underline{r}) \rvert k > \rvert^2 \delta(\omega_{k\lambda} - \omega)$, derivate the Planck's black-body radiation formula.	*20*
3.	A particle of mass (m) confined to one-dimensional box of width (L) with discrete eigen-states $\phi_n = e^{i(kx-\omega_n t)}/\sqrt{L}$ is exposed to perturbation: $\varepsilon[\hat{p}_x^2/(2m)][e^{-(t/\tau)^2}/(\tau\sqrt{\pi})]$, where $\varepsilon << 1$ and τ are constants. The perturbation is turned on at $(t = -\infty)$ when the unperturbed system is in its ground state ϕ_0. What is the probability that at $(t = +\infty)$ the system suffers a transition to the state ϕ_k, $k > 0$? [$\int_{-\infty}^{\infty} dx \exp(-x^2) = \sqrt{\pi}$]	*20*
4.	A particle of mass (m) and energy (E) moves in a large cubic box of length (L) scattered at a center of scattering of radial potential $V(r)$. Calculate the scattering amplitude $f(\theta)$ by the plane wave Born approximation. [The normalized plane-wave of a particle in a box of length (L) is $\lvert k > = e^{i\underline{k}.\underline{r}}/\sqrt{L^3}$, the energy distribution density in this box is $g(E_k) = mL^3 k/(2\pi^2\eta^2)$ and the rate of transition probability is $w_{kk'} = (2\pi/\eta) g(E_{k'}) \lvert < k \lvert V(r) \rvert k' > \rvert^2$]	*20*

With our Best Regards

Examiners:	*Prof. Essam M. Abulwafa (*)*	*Prof. Abeer A. Mahmoud*

Mansoura University Faculty of Science Physics Department	Physics Students	First Semester, 2015-2016 Credit hours Students: 4th level January, 2016 (26/01/2016) 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 spectrum of the electromagnetic radiation is divided into different regions. Discuss this phrase illustrating the different regions on a sketch diagram.	*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 photosphere temperature is 5800 k, and if sensors are located at: i- Mercury planet, ii- Earth, iii-Jupiter. $r_{Mercury}$ =0.58 x Earth 10^8 Km, r_{Earth} =1.5 x 10^8 Km, $r_{Jupiter}$ =7.78 x 10^8 Km, $R_{\odot}$ =6.96 x10^5 Km, σ = 5.67x10^{-8} w m^{-2} k^{-4}.	*15*
2-a)	If the sun temperature is 5785 ^{o}k, i-Determine Stefan Boltzman constant. ii- Compare between the calculated value of σ and the experimental one. ii- Using the given σ, determine the value of the solar constant of the earth. iii- Also determine the characteristic color of the spectra. h = 6.6252 x 10^{-34} J sec , k = 1.3806 x 10^{-23} J/ ^{o}k, $R_{\odot}$= 6.96 x10^8 m, C_o = 2.9979 x 10^8 m / sec , α = 2897.8 μm ^{o}k, r = 1.5 x10^{11} m, σ= 5.67 x 10^{-8}	*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 26 January 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 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: *i*- 0 – 0.39 μm. *ii*- 0.39 – 0.77μm. *iii*- 0.77 – 4 μm. *iv*- $\lambda > 4$ 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	4400	0.549	6300	0.762	17000	0.978
2300	0.120	4500	0.564	6400	0.770	18000	0.981
2400	0.140	4600	0.580	6500	0.776	19000	0.983

With My Best Wishes

Examiners:	*Prof. Magdy Tadros (*)*	*Prof. Eman Seisa*