المستوى الرابع - فيزياء - فيزياء الجوامد (٢) ف ٤٢٠

University of Mansoura Faculty of Science Physics Department Subject: Physics	2^{nd} Term : 4^{th} Years: Physics Date :May 2013 Time allowed : 2 hours
Course (s): (Phys. 420) Solid State Physics 2	Full Mark : 80 Mark

Answer the following Questions

1) Explain why mobile electrons appear in some solids and others not? Show how the free electron theory succeeded in explaining the wide spectrum of conductivity. **(20 Marks)**

2) Discuss the main concepts of the following models:
Dulong- Petit, Einstein, and Debye used for describing the relation between specific heat of solids and temperatures **(20 Marks)**

3) Define the terms and give physical meaning for the following:
   a) Thermal velocity. b) Drift velocity. c) Mobility
   d) Polarization and dielectric polarization
   e) Dielectric constant and dielectric loss **(20 Marks)**

4) Based on Free electron model calculate both DC and AC conductivities, explain carefully the physical meaning of your results. **(20 Marks)**

Examiners

1- Prof. Dr. F.M. Reicha **2- Prof. Dr. A. A. El-Bedawy**

المستوى الرابع - الفيزياء - فيزياء نووية (٣) ف ٤٢١

Mansoura University Faculty of Science Physics Department	Year: 4th Level Specialization: Physics Program	Second Semester , 2012-2013 June , 2013 Time: 2 Hours

Subject: Nuclear Physics Saturday 1/6/2013 12-02 PM

كود المادة : ف 421 / أسم المادة : فيزياء / أسم المقرر : فيزياء نووية (3)

Answer (5) Questions Only	(Full Mark : 80)	Mark
1-	Using Time-Dependent Perturbation Theory in Beta Decay to derive Fermi – Golden Rule number two.	16
2-	In Fermi theory of beta decay, describe the physical situation applied to the transition rate equation and calculate the square of the matrix element of interaction.	16
3a-	Classify in table the beta transitions according to ft-values.	10
3b-	Calculate the Log ft value forO^{14} (β^{+}) N^{14} decay. Given Q= 1.81 MeV, $T_{1/2}$ =70.6 s .	6
4a-	Describe and discuss the experiment of Reines and Cowan to detect neutrino .	10
4b-	Calculate the mean free path of 1.5 MeV neutrinos through water. Given $\sigma_{\nu H}$= 0.42×10^{-44} cm^2 .	6
5a-	Give and define each term in the classical and quantum mechanical expressions for the coupling energy between two magnetic dipole moments μ_I and μ_J for a hydrogenlike (single electron) atom of nuclear charge Z .	10
5b-	Consider the electronic ground state of the hydrogen atom , for which I =1/2 ,J = ½ and F= 0 or 1 . Calculate the difference in energy by using the quantum mechanical expression . Calculate also the frequency and wavelength of the photon emitted from the F =1 to the F =1 .	6
6a-	Study the effect of an external magnetic field on the hyperfine structure and determine Larmor precession. Calculate the Larmor frequency and the corresponding wavelength for μ = 1 nm , I = 1 and B =1 Wb/m^2 .	10
6b-	Review some of the main features of molecular excitations and transitions. Discuss the rotational part in greater detail.	6
	With our Best Wishes	

Examiners : Prof. Dr. Ali H. El-Farrash Dr. Ahmed Abu El-Ela*

**Corresponding Examiner*

المستوى الرابع - فيزياء - فيزياء البلازما ف 2013

Mansoura University Faculty of Science Physics Department Subject: Physics		Second Term Level : 4 Physics Date : June 2013 Time allowed : 2 hours
Course (s): Phys 422 **Plasma Physics**		Full Mark:: 80 Mark

Answer All Questions

[1] a- Explain the following:

1- Debye shielding 2- quasineutrality and collective behavior

3- Solitons.

b-

In laser fusion, the core of a small pellet of DT is compressed to a density of $10^{33}\,m^{-3}$ at a temperature of 30,000,000 K, Estimate the number of particles in a Debye sphere in this plasma .

[20] Mark

[2] Write short account on:

a- Dispersion
b- nonlinearity
c- double layer
d- Dielectric constant and refractive index of a plasma

[20] Mark

[3] a- Investigate the conditions for an ionized gas to be a plasma?

b- For the plasma system given by

$$\frac{\partial n_e}{\partial t}+\frac{\partial}{\partial x}(n_e v_e)=0,$$

$$m_e n_e\left[\frac{\partial v_e}{\partial t}+v_e\frac{\partial v_e}{\partial x}\right]=-\frac{\partial p_e}{\partial x}-en_e E,$$

$$p_e=n_e KT_e \, and$$

$$\frac{\partial}{\partial x}E=4\pi e(n_i-n_e)$$

where p_e, n_i, n_e, v_e, m_e and E are the pressure, ion density, electron density, electron velocity, electron mass and electric field respectively. Compute the plasma frequency and group velocity by Using a linear study. [20] Mark

المستوى الرابع - فيزياء - فيزياء البلازما ف 2cc

Mansoura University Faculty of Science Physics Department Subject: Physics		Second Term Level : 4 Physics Date : June 2013 Time allowed : 2 hours
Course (s): Phys 422 **Plasma Physics**		Full Mark:: 80 Mark

Answer All Questions

[1] a- Explain the following:

1- Debye shielding 2- quasineutrality and collective behavior

3- Solitons.

b-

In laser fusion, the core of a small pellet of DT is compressed to a density of $10^{33} m^{-3}$ at a temperature of 30,000,000 K, Estimate the number of particles in a Debye sphere in this plasma .

[20] Mark

[2] Write short account on:

a- Dispersion
b- nonlinearity
c- double layer
d- Dielectric constant and refractive index of a plasma

[20] Mark

[3] a- Investigate the conditions for an ionized gas to be a plasma?

b- For the plasma system given by

$$\frac{\partial n_e}{\partial t} + \frac{\partial}{\partial x}(n_e v_e) = 0,$$

$$m_e n_e [\frac{\partial v_e}{\partial t} + v_e \frac{\partial v_e}{\partial x}] = -\frac{\partial p_e}{\partial x} - e n_e E,$$

$$p_e = n_e K T_e and$$

$$\frac{\partial}{\partial x} E = 4\pi e(n_i - n_e)$$

where p_e, n_i, n_e, v_e, m_e and E are the pressure, ion density, electron density, electron velocity, electron mass and electric field respectively. Compute the plasma frequency and group velocity by Using a linear study. [20] Mark

[4] a- For ion acoustic motion

$$\frac{\partial n_i}{\partial t} + \frac{\partial}{\partial x}(n_i v_i) = 0,$$

$$\frac{\partial v_i}{\partial t} + v_i \frac{\partial v_i}{\partial x} = -\frac{e}{m_i}\frac{\partial \phi}{\partial x},$$

$$\frac{\partial^2 \phi}{\partial x^2} = -4\pi e(n_i - n_o \exp(-\frac{e\phi}{KT_e})).$$

For large amplitude prove that the equation of motion for this is given by

$\frac{1}{2}(\phi'^2) = M^2[(1-\frac{2\phi}{M^2})^{\frac{1}{2}} - 1] + \exp\phi - 1.$ and plot the phase plane, finally calculate U^2

In terms of the peak potential ϕ_{maX} where U is the velocity of propagation.

b- comment on the applications and uses of Plasma physics. [20] Mark

Examiners:

د. محمد قابيل ا.د. عماد الشيوي

المستوى الرابع - فيزياء - كم الكترونى ف ٤٢٣

Mansoura University Faculty of Science Physics Department	4^{th}-Level Physics	2^{nd} semester, 2012-2013 June, 2013 ***(2013-06-08)*** Time: 3 Hours

Ph 423: Quantum Electronics

Answer All the Following Questions: *(Full mark for written exam: 80)*		*Mark*
1.	Applying the free electron theory of metals, calculate the average value of the electron energy using the Fermi distribution at temperature T^oK $f(E) = 1/\{1+\exp[(E-E_F)/(kT)]\}$. $[\int_0^{\infty} dy \exp(-y^2) = \sqrt{\pi}/2]$	*15*
2.	For a metal of work function Φ and Fermi energy level E_F, derive the electron current density emission with respect to the temperature of the metal "Richardson equation". $[\int_{-\infty}^{\infty} dy \exp(-ay^2) = \sqrt{\pi/a}\,]$	*15*
3.	Consider a metal of surface barrier height E_c affected by a photo-beam of energy $h\nu$ has electron of energy component E_x in the direction perpendicular to the surface. Calculate the photo-current density perpendicular to the surface for $\nu < \nu_0$ and $\nu > \nu_0$ at temperature T^oK where ν_0 is the threshold frequency at 0^oK. $[\ln(1+x) = -\sum_{n=0}^{\infty} \frac{(-x)^n}{n}]$	*15*
4.	For a crystal of N-atoms arranged in one-dimension, assume the potential is a rectangular potential barrier of height (V_0), spacing (a) and thickness (b). Assume a very small thickness ($b \to 0$) while ($V_0 b$) remains constant. Describe the energy levels for electrons inside the crystal for all (V_0) values.	*15*
5.	Consider a three-dimensional crystal of atoms arranged in a periodic pattern in space with lattice vector ($\underline{R}$), number of atoms N_1, N_2, N_3 and lattice vectors $\underline{a}_1$, $\underline{a}_2$, $\underline{a}_3$ in the three directions, respectively. Find the reciprocal lattice vectors $\underline{b}_1$, $\underline{b}_2$, $\underline{b}_3$ and the momentum vector $\underline{k}$ of the Bloch function for bcc crystal.	*20*

With our Best wishes

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

المستوى الرابع - فيزياء - ميكانيكا إحصائية فيز ٤٢٤

Mansoura University Faculty of Science Physics Department **Subject : Physics**	Forth Year Physics	**Second Term** **Forth Year : Physics** **Date : 11/6/ 2013** **Time allowed : 2 hours**

Statis.Mech. ph (424)

Answer the following questions

(1) a - Verify the conservative nature of phase space volumes and derive the equation of motion for a statistical ensemble . (20)

b - Calculate the phase space volume for a system contains 10 particles moving freely in a volume V .

(2) a - Write down the canonical Gibbs distribution and show that it for an ideal gas contains the Maxwell- Boltzmann distribution . (20)

b - Use the canonical Gibbs distribution to obtain Helmholtz equation $\bar{H} = \Psi - \theta \frac{\partial \Psi}{\partial \theta}$

(3) a- Derive Gibbs lemma , $\frac{\partial \bar{u}}{\partial \theta} = \frac{1}{\theta^2} \overline{(u - \bar{u})(H - \bar{H})}$ where u is an arbitrary mechanical quantity . (20)

Calculate the relative fluctuation of energy $(\Delta E / E)$

b- Utilize the virial theorem and the equipartition law of energy to obtain the mean energy of a particle moving in an external field with potential $U(r) = A\, r^6$.

(4) Answer **only** **a** or **b** . (20)

a – (i) The partition function for a real gas in thermal contact with a heat reservoir could be written in the form $z = z_0\, z_{int}$ where z_o is the partition function for the ideal gas and z_{int} is the partition function of interaction , find an expression for z_{int}.

(ii) Calculate z_{int} in case of a rarified gas with molecules interact in pairs according to $\phi(r) = \frac{A}{r^4}, A > o.$

b – Write down the Gibbs distribution for a system with a variable number of particles and obtain the average pressure and average number of particles for the system in terms of the grand potential Ω .

With best wishes

Hayam Mashaly

للمستوى الثالث - فيزياء - فيزياء رياضيات (٢) ف ٣٢٥

Mansoura University
Faculty of Science
Physics Department

جامعة المنصورة
كلية العلـــــوم
قسم الفـــيزياء

Second Term Examination
Physics. Stud.
Time: 2 hours
Date: 13/6/2013

Full mark: 80 mark

Educational Year: Third Level
subject: Physics
Course: Phy325.
Mathematical Physics 2

Answer the following questions.

1-a- Classify the following partial differential equations

$i-u_{xx}+u_{yy}+sin(u)=0,$ $\quad$ $ii-x^2u_x+u_y=sin(x)$ **(8mark)**

1-b- Verify that the following function is a solution of the given PDE

$i-u_{tt}=a^2u_{xx},$ $\quad$ $u(x,t)=sin(at)cos(x)$

$ii-u_{yy}+u_{xx}+u_{zz}=0,$ $\quad$ $u(x,y,z)=\frac{1}{\sqrt{x^2+y^2+z^2}}$ **(12mark)**

2- Solve the following problem

$u_t(x,t)=u_{xx}(x,t)-u(x,t),\quad 0<x<1,\quad 0<t<\infty$

$Bcs\ \begin{cases} u(0,t)=0 \\ u(1,t)=0 \end{cases},$ $\quad IC \quad u(x,0)=sin(\pi x)$ **(20mark)**

3-Prove that

$i-\mathcal{F}_s(\ddot{f})=\frac{2}{\pi}\omega f(0)-\omega^2\mathcal{F}_s(f)$

$ii-\mathcal{L}\{f^{(n)}\}=s^n\mathcal{L}\{f\}-s^{n-1}f(0)-\cdots-f^{(n-1)}(0)$ **(20mark)**

4- Using the Laplace transform to solve the following equation

$u_t(x,t)=u_{xx}(x,t)\quad ,0<x<\infty,0<t<\infty$

With $\quad Bc\ \ u(0,t)=sin(t),\ IC\ \ u(x,0)=0$ **(20mark)**

With best wishes

Examiners: Dr. Abeer Awad, Prof. Dr.S.A.El-Wakil

. المستوى الرابع - فيزياء - فيزياء نظرية ف ٤٢٦

Mansoura University
Faculty of Science
Physics Department

4th level physics students
Full Mark: 80
Allowed time: 2 hours
Course title: Non linear physics
Course code: Phys 426

Second Semester

Date:8-6-2013

<u>Answer the following questions</u>: **Marks**

		Marks
1-	Classify the fixed points of the two following system and study the phase plane for each i. $\dot{x} = x(4-x-y)$, $\dot{y} = xy - 2y$. ii. $\dot{x} = y$, $\dot{y} = -\frac{g}{L}\sin x - \lambda y$.	20
2-	i. Show that regular perturbation fails on the boundary value problem $\varepsilon y'' + (1+\varepsilon)\, y' + y = 0, \quad y(0) = 0, \quad y(1) = 1$ ii. Using singular perturbation to solve this problem. iii. Find the inner and outer approximations from the exact solution.	20
3-	Derive and discuss (i) the travelling wave solutions and (ii) similarity solution of the KdV equation $u_t - 6uu_x + u_{xxx} = 0$	20
4-	Show that the following system of equations admits a limit cycle $\dot{x} = x + y - x(x^2 + y^2)$, $\dot{y} = -x + y - y(x^2 + y^2)$	20

Best wishes:

Examiners: * أ.د/ عطالله الحنبلى