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Mansoura University
Faculty of Science
Physics Department.
Subject: Physics(316)
Title: Advanced optics



Final term exam – First Term Third level /physics Date: Jan. 2014 Allowed Time: Two hours.

Full Mark: 80

Answer the following questions

- [1] a- Discuss Raman scattering theory in a classical frame work?

 [15]Mark
 b- Explain, giving both theory and experimental details, how you
 would produce elliptically and circular polarized light? [15]Mark
- [2] a-Calculate the electric field at a large distance from a thin glass plate if a source of light is placed at a large distance from its opposite side?

 [15] Mark
 - b- Write briefly about the quarter wave plate? Calculate the thickness required for a quarter wave plate having n_o = 1.768 and n_E = 1.760 using light of wavelength λ = 5893 Å. [10] Mark
- [3] a- Derive Rayleigh equation for elastic light scattering by isolated small particle in vacuum illuminated by plane polarized light?

 [15] Mark
 - b- Describe the anomalous dispersion phenomenon using Sellmeier mechanism (clarify your answer with suitable drawing)? [10] Mark

Best wishes: Prof. Dr. Kermal El-Farahaty

Mansoura University
Faculty of Science
Department of Physics
Course Code: Phys. 311
Title: Solid State Physics



First Semester (Jan. 2015) Exam Type (Final):

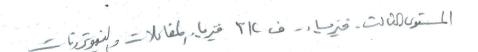
3rd Year (Physics, Biophysics)

Time: Two Hours Full Mark: 80 Mark

Answer only three questions from the following

- 1- a: Density of FCC copper is 8.96 g/cm^3 and its atomic mass is 63.54 g/atom. Find the Bragg angle for the first order reflection from the planes (110) at $\lambda = 0.5 \text{ Å}$. Will there be any higher order reflections? [14 Mark]
 - **b:** Derive a relation for the separation distance between planes in a crystalline structure. Is that relation valid for all types of lattices? [13 Mark]
- **2- a:** The energy of interaction of two atoms a distance r apart can be written as: $U(r) = -(a/r) + (b/r^7)$ where a and b are constants.
 - (i) Show that for the particles to be in equilibrium, $r = r_0 = (7b/a)^{1/6}$.
 - (ii) In stable equilibrium, show that the energy of attraction is seven times that of the repulsion in contrast to the forces of attraction and repulsion being equal. [14 Mark]
 - **b**: Which type of cubic lattice has the highest packing density? Give a proof. [13 Mark]
- 3- a: Describe an experimental method for determination of the separation distance between planes in a crystalline structure. [14 Mark]
 - **b:** Can gamma rays be used to study the crystalline structure? Explain! [13 Mark]
- 4- a: Show that the bulk properties of a solid does not depend on its volume. [14 Mark]
 - **b:** Write down the atomic radii *r* in terms of the lattice constant *a*, for:
 - (i) Simple cubic structure, (ii) FCC structure, (iii) BCC structure. [13 Mark]

أطيب التمنيات: أ.د. حمدی دويدار (مُعبرُ وَيرُ الرَّمِرُ وَي الدَّ الدَّمِرُ وَي الدَّ الدَّمِرُ وَي الدَّمِرُ وَي الدَّمِرُ وَي الدَّمِرُ وَي الدَّالِ الدَّالِي الدَّالِي الدَّالِ الدَّالِي الْمُعْلِي الْمُعْلِي



Mansoura University **Faculty of Science Physics Department**

Course code: ph 312



3rd level Physics Students Full Mark: 80 Allowed time: 2 hours Course title: Theo. React. Physics

First semester 2014-2015

Date: 29-12-2014

Answer the following questions:

1-A-Define the following quantity:	8
i- The reactor ii- The cross section of an event iii- The neutron angular	density
iv- The reaction rate v- The scattering angle. (10 Mark)	
1-B- Derive the neutron transport equation in term of the angular density	(10Mark)
2-Write short notes about the nuclear reactors, and take an example of the	reactors to
show how obtained the electricity.	(20 Mark)
3-a- Using the Fick's rule to derive the diffusion equation	(15 Mark)
3-b- Show the relation between the mean free path and the macroscopic cro	ss section.
	(5 mark)
4- Consider a homogeneous bare slab reactor with inner width 2a, and oute	er width 2b.
Calculate the eigen values of the one speed transport equation, and Criticali	ty factor for
the emitting neutrons.	(20 Mark)

Best wishes:

Prof. Dr. S. A. El-Wakil & Dr. Abeer Awad

Mansoura University Faculty of Science PHYSICS DEPARTMENT

Final Exam - 1st Term (1 Jan. 2014)

Third Level Students (Special Physics)

Course: Math. Physics 1 (Phy315)

Time allowed: 2 hours

Full Mark: 80 (Every question: 20 Mark)

Answer the following questions

Q1: A) Estimate the following integrals by using Gamma and Beta functions:

i)
$$\int_{0}^{\pi} \tan^{5/2}(x/2) dx$$

ii)
$$\int_0^1 \sqrt{\frac{1}{x} - 1} \ dx$$

ii)
$$\int_0^1 \sqrt{\frac{1}{x} - 1} dx$$
 iii) $\int_0^\infty \exp\left(-\frac{x^2}{4}\right) dx$

B) Prove the relation between Beta and Gamma functions as: $B(x,y) = \frac{\Gamma(x)\Gamma(y)}{\Gamma(x+y)}$

Q2:

A) Prove Rodrigues formula of the Legendre Polynomials as: $P_n(\mu) = \frac{1}{2^n n!} \frac{d^n}{d\mu^n} (\mu^2 - 1)^n$

i)
$$\int_{-1}^{1} x P_n(x) P_{n-1}(x) dx = \frac{2n}{4n^2 - 1}$$
 ii) $P_3(x) = \frac{1}{2} (5x^3 - 3x)$

ii)
$$P_3(x) = \frac{1}{2}(5x^3 - 3x)$$

O3:

A) Prove that the generating function of the Bessel functions $J_n(x)$ can be expressed as:

$$\exp\left[\frac{x}{2}\left(t - \frac{1}{t}\right)\right] = \sum_{n = -\infty}^{\infty} t^n J_n(x)$$

B) i) Show that:
$$\int$$

$$\int_0^\infty e^{-x} J_0(x) dx = 1$$

ii) Evaluate
$$\int_{-\infty}^{\infty} x e^{-x^2} H_i(x) H_j(x) dx$$

04:

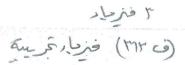
A) What is the relation between Weber-Hermite function $\Psi_n(x)$ and Hermite function $H_n(x)$? Explain how can you obtain the expression of Weber-Hermite function in terms of Hermite function and solve the corresponding Weber-Hermite differential equation.

B) For Laguerre polynomial functions $L_n(x)$, prove its orthogonality property as

$$\int_0^\infty e^{-x} L_n(x) L_m(x) dx = \delta_{nm}$$

With my best wishes

Dr. M. Sallah



Mansoura University

Faculty of Science

Physics Department

First Term Examination,

Third Year: Physics, 313

Date: 2/1/2015

Time: 2 hours

Course (s): Methods of Experimental Physics

Full Mark: 80 Mark

Answer the Following Questions

[1] a- Describe the working of a rotary oil pump for producing law pressures.

[10 Marks]

b- Calculate the root mean square velocity (r.m.s) velocity of the nitrogen molecules at 0 °C. the density of nitrogen at N.T.P is 1.25 g/cm³ and g=981 cm/s². [10 Marks]

c- Discuss the factors usually considered for the selection and choice a pump.

[10 Marks]

[2] Account on the following:

i- The quartz spectrograph.

[10 Marks]

ii- Flame photometer as a tool in spectrum analysis.

[10 Marks]

iii- Photographic process.

[5 Marks]

[3] Account on the following:

i- Light losses in spectrographs.

[10 Marks]

ii- Fogging produced in the photographic plates.

[10 Marks]

iii- Give some examples for systematic errors and random errors.

[5 Marks]

With best wishes

أ.د. المتولى عبد الرازق

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أ.د . إبراهيم فوده

Mansoura University **Faculty of Science Physics Department** Course: Phys. 314



Quantum Mechanics

First Term Exam. Jan. 2015 3rd year Phys. and Bio-phys. Allowed Time: 2 hours Full Mark: 80

Answer the following questions:

[1-a] Write on the basic postulates of quantum mechanics.

[5 Marks]

[1-b] A beam of mono-energetic particles of energy E moves freely in x-direction is subjected to a potential jump of height V_0 <E. Determine the reflection and transmission coefficients of the beam and compare the results with those calculated classically.

[15 Marks]

[2-a] Using the time-independent perturbation theory to estimate the first order corrections on the energy eigen-values and their corresponding eigen-functions of a particle moves in a perturbed system. [12 Marks]

[2-b] Verify that $[x^2, P_x] = 2ihx$, and calculate [E,t].

[8 Marks]

[3-a] Solve the one-dimensional Schrodinger equation to determine the allowed energy levels of a particle moves freely inside an infinite potential well of width L. [12 Marks]

[3-b] If this potential is perturbed by $\mathbf{H'}=V_0$ in the region 0 < x < L/2, calculate the 1st order correction on the ground state energy of the particle. [8 Marks]

[4-a] Determine the allowed energy levels and the corresponding eigen functions of a one-dimensional harmonic oscillator. [15 Marks]

[4-b] Discuss the degeneracy of a spherical harmonic oscillator and calculate its value for the 2nd excited state energy level (N=2). [5 Marks]

WITH OUR BEST WISHES

Examiners:

Prof. Dr. A. R. Degheidy and

Dr. E. B.Elkenany

Mansoura University
Faculty of Science
Physics Department

First Semester "Jan.2015"

Metal Physics Exam – Phys-317

Third Level Physics "Group 1" -

Total Mark [80]

Time Allowed TWO HOURS

ANSWER THE FOLLOWING QUESTIONS:

Q.1: A Copper wire of cross –sectional area 3×10^{-6} m²carries a current 10 A. Find the drift velocity of electrons in this metal wire. The density of copper is 8.95 g/cm^3 , the atomic weight is 63.5 g/mole. Estimate the average time between collisions for electrons in copper at 20°C , where the resistivity of copper is $1.7 \times 10^{-8}\text{Ohm-m.Compute}$ the average electron energy in a metal at zero Kelvin. Avogadro's number, 6.02×10^{-23} , electron mass, $9.109 \times 10^{-31}\text{Kg}$, Planck's constant $6.63 \times 10^{-34}\text{Js}$, electron charge = $1.602 \times 10^{-19}\text{Coul.}$, 1eV - $1.602 \times 10^{-19}\text{J}$, 1Cal=4.2 J, Copper is monovalent. [20Mark]

Q.2 : Give possible reasons why Trivalent and Quadrivalent are metallic in character, and why metal crystallize typically in one of three structures, namely: BCC, FCC, and HCP structure?. [20Mark].

Q.3: (a): Explain why electrons make only small contributions to the specific heat of a metal? [10Mark]. (b): The element sodium has density 0.97 x 10^3 Kgm⁻³, relative atomic mass 23 and electrical conductivity 2.1x107 Ohm⁻¹.m⁻¹. Determine (i) the thermal conductivity at 20° C of the element sodium by knowing that the numerical value of Lorenz number is $5.2x10^{-9}$ cal.ohm/s.deg²and (ii) the mobility of electrons [10Mark].

Q.4 (a): Explain the meaning of the phase transformations in metals and illustrate your answer with examples. [10Mark]. (b): Consider a cube of gold 1mm on an edge. Calculate the approximate number of conduction electrons in this cube whose energies lie in the range 4.000 eV to 4.025 eV. [10Mark].

Prof.Dr. Mustafa Kamal.

انتهت الأسئلة:

Mansoura University Faculty of Science Physics Department Subject: Physics



First Term

Third Year: Physics Date: 5-1-2014.

Time allowed: 2 hours

Course (s): Phys 310

(Statistical Thermodynamics)

Full Mark: 80 Mark

Answer the following Questions: Each Question [20] Mark

[1] Deduce the Maxwellian distribution for molecular velocities.

[2] Find:

a) Plank's law of black body radiation and

b) Maxwell- Boltzmann velocity distribution

Using Bose-Einstein distribution functions.

[3] Derive the distribution function of Fermi – Dirac statistics.

[4.a] A system consists of two particles. Suppose that the system has two energy level, where $\epsilon_1=0$, $\epsilon_2=\epsilon$, $g_1=g_2=1$. Calculate the partition function for

- (a) a single particle
 - (b) two particles (distinguishable)
 - (c) two particles (indistinguishable)

[4.b] Derive the energy distribution of molecular speed

With my best wishes Prof. Dr. A. Elgarayhi

Examiners: 1. Prof. Dr. A. Elgarayhi

2. Dr. M. Mansour