Final Exam – Second Term: 2014/2015 - Course Title: Physics of Low Temperature P- 422- Time: 3h - Prof. Dr. Ahmed Sedky

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***Answer the following questions*:**

Q1(10 marks):

(a) Explain with the required diagram the behavior of applied field against thickness of superconductor.

(c) Calculate the T_c of ^{205}Hg isotope when T_c of ^{200}Hg = 4.16 K.

(d) Prove that the BCS energy gap at 0 K is given by $E_g(0) = 3.52K_BT_c$.

Q2(10 marks):

(a) Write only the main difference between type (I) and type (II) superconductors in terms of surface energy and G-L parameter.

(b) Clarify in details how the flux creep occurs in a superconductor, and then explain with drawing how you can determine the activation energy of flux bundles.

(c) Write only the type of crystal structure, and T_c, J_c (0) and H_c (0) values for Y:123, Ti: 2223 and MgB_2 high T_c systems.

Q3(10 marks):

(a) Discuss the effect of inclined field on the surface sheath of type (II), and then explain by calculations that type (I) would carry a surface sheath.

(b) According to BCS theory, calculate the expected size of electron pairs in conventional and high T_c superconductors, and then compare them with the normal state.

(c) Calculate the reduced electron pair density at 20 K for a superconductor if $T_c = 40$ K.

Q4(10 marks):

(a) Prove experimentally that you can easily determine the type of charge carrier and also the energy gap in a superconductor.

(b) Clarify in details how you can use a superconductor in only one of its applications.

(c) If $\lambda_L = 1.2$ nm and $K_{GI} = 0.955$ for a superconductor, calculate by *nm* the spacing of vortex lines when flux flow resistance was increased up to twice value of the normal state.

0

Q5(10 marks):

(a) Prove experimentally that you can easily determine the flux flow resistance along a flat strip of type II superconductor in mixed state.

(b) Consider a cylindrical superconducting wire of $V = 3.14\ cm^3$, $\ell = 4$ cm, $R = 4\ m\Omega$, $T_c = 30$ K and $H_{c2}(0) = 5000$ Oe. Calculate the electronic specific heat coefficient at $T \sim T_c$ and the critical current at the same field.

جامعة أسيوط	الفصل الدراسي الثاني	مقرر:
كلية العلوم	2014-2015 م	الوقت: 2 ساعة
قسم الفيزياء	أختبار تحريري - تطبيق الحاسب	نهائي الفصل

Answer the following questions:

1. Write down the Computer's Mathematica order for the following:
   i. Draw a circle of radius equal to 1.7.
   ii. Draw a straight line with a slope equal to 1.02.
   iii. Get the value of "x" in the equation: $x^3 - 4 = 0$.
   iv. Draw the two functions $\{x^2, x^3\}$ on the same graph.
   v. Draw a straight line parallel to the x-axis.
   vi. Draw a circle with center at (1,2) and radius equal to 1.5.
   vii. The numerical value of $(x \cos x)^{1/2}$ for $x=45^\circ$.
   viii. Draw a straight line tangential to the circle in (i).
   ix. Get the value of x in the equation: Ln[x]=Cos[x]
   x. Draw two circles inside each other with their center at (1, 2).

2. Write down in detail how can you evaluate the square root of the number 7 from the algebraic equation: $x^2 - 7 = 0$, by the iteration technique. Can you do the same for the equation: $x^2+10=0$?

3. Correct the following statements and explain their meanings:
   i. pLOT $\{-(1-x^2)^{1/2}, x\}$.
   ii. Plot[y=0.5x+0.5]
   iii. solve[$x^2+2=0$,x]
   iv. Drew[$(1+x^2)^{1/2}$,$-(1-x^2)^{1/2}$]
   v. plot[$(1-x^2)^{1/2}$,0.5x+$(1,25)^{1/2}$]
   vi. Plot[{u*Cos[u],Sin[u]/u},{u,-5,5)]
   vii. Expand [$(x-3)^3(x+14)^2$]

تنبيه مهم: عند كتابة أي امر يدويا يجب وضع خط تحت الحروف ال Capital .

Assiut University
Faculty of Science
Department of Physics

Undergraduate
Final Exam (50%)

2nd semester 2014-2015

Course : Radiation Physics
Code : P444
Section : Phys. and Phys./Chem.
Time : 3 Hours
Date : 10/6/2015

Answer the following question:

Question (1): **(10 Mark)**

Write number of each statement and put [√] or [×], then discuss your answer (if √ or ×):

1- The fission process is used as a source of neutrons.

2- Symmetric IF increases with increasing energy of incident particle.

3- Fission material usually splits into same two fission fragments each time of decay.

4- Bremsstralung radiation becomes important for heavier incident charged particle and lighter target.

5- In seqular equilibrium, the number of parent nuclei remains unchanged.

6- IC is a competing process of γ–rays.

7- Radioactivity is the artificial disintegration of nuclei.

8- Nuclei emit α-particles with higher kinetic energy T_α will have longer decay constant than nuclei emit α-particles with smaller T_α.

9- Condition for α decay to be possible is: $M(A, Z) > M(A, Z+1) + M(4, 2)$.

10- β^+ particles emitted from radioactive decay is monoenergetic electrons.

Answer four (4) only of the following questions:

Question (2): **(10 Mark)**

a) Define the branching of radioactivity and derive the branching decay law and total half life of the element. (6 points)

b) The isotope $^{252}_{98}Cf$ decays by alpha decay and by spontaneous fission. The total half-life is 2.646 years and the half-life for alpha decay is 2.731 years. What is the number of spontaneous fissions per second per 10–3 kg (1g) of $^{252}_{98}Cf$? (4 points)

Question (3): **(10 Mark)**

a) Discuss the decay of radioactive element by emission of β^+ particles. (6 points)

b) The element $^{131}_{53}I$ decay by emitting β^- with $T_{max} = 0.608$ MeV. Residual nucleus $^{131}_{54}Xe$ is left in an excited state and emits γ–rays with total energy 0.364 MeV. Draw energy level diagram in both mass and energy scales. Consider the atomic mass of $^{131}_{54}Xe$ in its ground state is 130.905058 u. (4 points)

Question (4): **(10 Mark)**

a) What is the ionizing radiation and what are the different sources of it? (5 points)

b) What is the induced fission? Discuss in details different types of it. (5 points)

Question (5): **(10 Mark)**

a) Derive an expression for decay energy for symmetric SF indicating that the fissionability parameter should be greater than 49. (6 points)

b) α particles emitted from $^{210}_{84}Po$ has kinetic energy of 5.3 MeV and residual nucleus of $^{206}_{82}Pb$ is left in its ground state. Calculate the decay energy and kinetic energy of residual nucleus. (4 points). (4 points)

Question (6): **(10 Mark)**

a) Define the stopping power and derive Bohr's formula for the stopping power. (7 points)

b) Show the parameters that stopping power depends on. (3 points)

Faculty of science Physics department	Semiconductor physics, thin films and its application (451p) Date: 18/6/2015 time: 3hrs	

Answer the following questions:

1. (a) Explain three of the following (preparation, characterization and application) :

1. Light emitting diodes.
2. Solar cells.
3. Semiconductor laser diode.
4. Photodiode and photo-detector.

(b) Discuss the different types of exciton absorption process in semiconductors.

(12 mark)

2. (a) Drive an equation for the density of holes in the intrinsic semiconductors.

(b) The complex dielectric constant of CdS is given by the relation:

$$\varepsilon^* = 10.5 + i\ 3.6$$

At wavelength $\lambda = 540\,nm$. Deduce the refractive index (n), the phase velocity (υ), the extinction absorption coefficient (α) and the reflectivity (R).

(c) The band gap of an alloy semiconductor gallium arsenide phosphide is 1.98 eV. Calculate the wavelength of radiation that is emitted when the direct recombination from conduction band to valence band between electrons and holes occurs.

(12 mark)

3. (a) Explain in details two of the following:

1. Photoemission and recombination process of charge carriers in semiconductors.
2. Diffusion and drift currents.
3. Photoconductivity in semiconductors.

(b) Deduce an expression for direct absorption transition. (12 mark)

4. (a) Write on the different types of experimental techniques of thin films preparation.

(b) Determine the position of Fermi level and calculate the density of holes and electrons for an intrinsic semiconductor at 300 °K with energy gap, E_g= 0.7 eV, m^*_p = 6 m^*_e and C=4.83*102.

(14 mark)

جامعة أسيوط	امتحان دور يونيه 2015م	الفرقة : الرابعة
كلية العلوم	مقرر 432 ف	الزمن : 3 ساعات
قسم الفيزياء	أطياف ذرية وجزيئة	الشعبة : فيزياء

أجب عن خمسة أسئلة فقط مما يأتي

1- اشرح تأثير زيمان العادى وكيف تفسره ثم احسب إزاحة زيمان. (10 درجات)

2- اشرح قاعدة هوند ومنها احسب الحد الطيفى الاساسى لكل من الكروم و الكوبالت والنحاس علما بان العدد الذرى لكل منهم هو 24 ، 27 ، 29 على الترتيب. (10 درجات)

3- أ- اكتب مقال مختصر عن طيف الامتصاص فى الجزئ ثنائى الذرية. (5 درجات).

ب- اكتب مقال مختصر عن الطيف المستمر فى الجزئ ثنائى الذرية. (5 درجات)

4- اشرح بالتفصيل تركيب وطاقة وطيف الجزئ ثنائى الذرية كمذبذب غير توافقى . (10 درجات)

5- الجدول التالى يبين الاعداد الموجية لبعض الحزم الطيفية للحزمة (0 – 0)

J	R(J)	P(J)
0	21199.81	
1	21202.88	21193.25
2	21205.74	21189.97
3	21208.52	21186.41
4	21211.12	21182.66
5	21213.58	21178.88
6	21215.58	21171.82

أ- أوجد الثوابت الدورانية $(\overline{\overline{B}}, \overline{B})$ عند العدد الكمى J=3.

ب- أحسب موضع رأس الحزمة وفى أى فرع هى.

ج- أحسب الإزاحة بين رأس الحزمة وأصل الحزمة. (10 درجات)

6- اشرح بالتفصيل تركيب وطاقة وطيف الجزئ ثنائى الذرية كقمة متماثلة. (10 درجات)

Assiut University
Faculty of Science
Department of Physics

2nd term 2014/2015
Date: 15-6-2015
Time allowed: 3 hours

Course title: Nano materials and its applications
Cod :458 P

Answer the following questions:

Q1-Chose the correct answer in the following MSQ: *(10 marks)*

Nanoscale materials may differ from micro-scale materials in the following aspects:-

1– Gravitational forces become (strong, weak , intermediate) and electromagnetic forces dominate.

2– The density of states for the bulk material is proportional to(E^2, or $E^{0.5}$ or $E^{n)}$.

3- As the grain size (D) of the solid decreases, the number of atoms located at or near grain boundary (relative to those inside the grain)becomes proportional to (D or1/D or D^2).

4- Melting point (decreases , increases, still as a constant) when the particle size reduces.

5- Quantum dots are small semiconductor particles with (size dependent, size independent ,or constant) band gap.

6- Surface atoms require(large,small) energy to move ,because they are in contact with larger number of atoms of the substance.

7- The mechanical strength of the materials becomes much (larger ,or less) than that for the micro sized or bulk.

8- Random molecular motion becomes (more, less) Important.

9-The specific surface area (total surface area per unit mass) in the nanoparticles is usually very high.

10- In nanoparticles, the number of atoms at the surface is (equal, larger , negligible) compared to those in the nanoparticles interior.

Q2- (a) Given the following data for GaAs :- $m_e = 0.067\ m_0$, $m_h = 0.45\ m_0$, $\varepsilon = 12.4$, $h/2\pi = 1.054 \times 10^{-34}$ j.S. Calculate 1- The effective mass. 2.Exciton Bohr radius for GaAS. *(5 marks)*

(b) Explain the changes to the system total energy due to the nanoscale length scale. *(5marks).*

Q 3- Write about only two of the following: *(10 marks)*

1-Electron beam lithography .

2- Sol-Gel technique as a chemical bottom-up method.

3- Physical vapor deposition by sputtering.

Q4- Explain the principle, operation modes and limitations of scanning tunneling microscopy. *(10 marks)*

Q5-(a)Explain the working principle of Atomic force microscope ,and mention the differenc between STM and AFM. (*7 marks*) . (b)- Define:nanoscale, nanotechnology, nanomaterial. (*3 marks*) .

Bestwishes,Profdr.AlyOthman