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SEAT No._____ SARDAR PATEL UNIVERSITY

[2173]

M.Sc. (Physics) (III[rd] – Semester) Examination

Day &Date :Monday, 29/10/2018

Time: 02:00 p.m. to 05:00 p.m.

Subject : PHYSICS, Subject Code: PS03EPHY22

Title: Magnetic and optical properties of condensed matter

Instruction:

Figure to the right indicate marks. Total Marks : 70

Q.1 Write answer of all questions by showing your choice against the question number. [8]

(i) In Franck-Condon principle, Optical excitation process takes place in time interval _____compared with time period associated with lattice vibrations.

(a) zero (b) same (c) large (d) small

(ii) _____ equation used to calculate intensity of the luminescent material in case of temperature dependent exponential decay.

(a) $I(t) = I_0 \exp\left(\frac{t}{\tau}\right)$ (b) $I(t) = I_0 \exp\left(\frac{\tau}{t}\right)$ (c) $I(t) = I_0 \exp\left(-\frac{t}{\tau}\right)$ (d) $I(t) = I_0 \exp\left(-\frac{\tau}{t}\right)$

(iii) Doppler broadening (D) is calculated by using equation_____.

(a) $D = 1/\sqrt{4RK_BT}$ (b) $D = 4RK_BT$ (c) $D = 1/(4RK_BT)$ (d) $D = \sqrt{4RK_BT}$

(iv) Natural line width arises because of time spent by _____ from excited state to ground state.

(a) electron (b) molecule (c) nucleus (d) atom

(v) The losses in dielectric subjected to an alternating field are determined by:

(a) real part of complex dielectric constant

(b) imaginary part of complex dielectric constant

(c) both real and imaginary part of complex dielectric constant

(d) none of these

(vi) The dipole moment per unit volume of a solid is sum of all the individual dipole moments and is called:

(a) polarization of the dipole (b) permittivity of the solid

(c) electrostatic moment (d) none of these

(vii) At Neel temperature, ferromagnetic material has:

(a) permeability is minimum (b) permeability is maximum

(c) susceptibility is minimum (d) susceptibility is maximum

(viii) The magnetic material in which permanent magnetic dipoles (due to electron spin) are already aligned due to bonding forces are known as:

(a) paramagnetic materials (b) ferromagnetic materials

(c) antiferromagnetic materials (d) diamagnetic materials

Q.2 Attempt any Seven of the following questions: [14]

(i) Define different types of the luminescence.

(ii) Explain the excitation process involved by diffusion of excitons in phosphors.

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(P.T.O.)

(iii) Give the reasons for broadening of the spectral line in Mossbauer effect.
(iv) Calculate the recoil velocity of Mossbauer nucleus of mass is 1.67×10^{-25} kg when emitting a gamma ray of wavelength 0.1 nm. What is the Doppler shift of gamma ray frequency?
(v) How radiationless transition possible in phosphors?
(vi) Explain the free carrier absorption in semiconductors.
(vii) Why transformer oil should be tested regularly?
(viii) In Magnon understanding why linearized equation $\frac{dS_p^z}{dt}$ is taken as zero.
(ix) Write the general resonance frequency equation of ferromagnetic resonance, if the specimen is spherical in shape, thus demagnetization factors N_x, N_y and N_z are equal to each others, then derive the resonance frequency ω_o.

Q.3(a) (i) Using necessary diagram, explain how efficiency of phosphors is decreasing as temperature is increasing. [3]
(ii) Obtain the expression for the intensity using power decay law for luminescent material. [3]

Q.3(b) Describe absorption and emission spectra of pure KCl crystal and thallium doped KCl crystal in detail. Also mentioned its requirements. [6]

OR

Q.3(b) Write a short note on sulphide phosphors using necessary schematic diagrams. [6]

Q.4(a) Sketch the schematic experimental set up of Mossbauer effect and describe its working, conditions and requirements of this effect. [6]

Q.4(b) Derive the expression of Debye-Waller factor and prove that this factor depends temperature. [6]

OR

Q.4(b) Using necessary diagram explain quadrupole interaction in Mossbauer spectroscopy in detail. [6]

Q.5(a) Explain the fundamental absorption and the absorption processes involving impurities in semiconductor using suitable diagram. [6]

Q.5(b) Explain propagation of light in conducting media and the Drude mode. [6]

OR

Q.5(b) Explain in detail the terms complex dielectric constant and dielectric loss. [6]

Q.6(a) With appropriate symbol and necessary mathematical formulation derive expression for anti-ferromagentic resonance frequency. [6]

Q.6(b) Taking an example of magnetite explain ferromagnetic order in detail. [6]

OR

Q.6(b) Discuss the unusual features of ferromagnetic resonance. Derive the equation of ferromagnetic resonance frequency for elliptical sample. [6]

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