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SEAT No.________

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[112]

SARDAR PATEL UNIVERSITY

M.Sc. (PHYSICS) (IIIrd – Semester) Examination

Day & Date: Wednesday & 27/03/2019

Time: 10:00 AM to 01:00 PM

Title: MAGNETIC AND OPTICAL PROPERTIES OF CONDENSED MATTER

Course Code: PS03EPHY22

Instruction: Figures to the right indicate marks.

Total Marks: 70

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

(1) As temperature increases, the efficiency of luminescent material is ___________.
(a) constant (b) increases (c) decreases (d) zero

(2) The equation ____________ is used to calculate the intensity of phosphors for temperature independent exponential decay.
(a) $I(t) = I_0 \exp\left(\frac{\tau}{t}\right)$ (b) $I(t) = I_0 \exp\left(-\frac{\tau}{t}\right)$ (c) $I(t) = I_0 \exp\left(\frac{t}{\tau}\right)$ (d) $I(t) = I_0 \exp\left(-\frac{t}{\tau}\right)$

(3) When R. W. Wood introduced NaCl in Bunsen flame, he observed that bright __________ patch on screen focused by lens system.
(a) Green (b) red (c) yellow (d) orange

(4) Natural line width arises because of the time spent by the nucleons:
(a) from ground state to excited state (b) in excited state
(c) in ground state (d) from Excited state to ground state

(5) The free carrier absorption of photon occurs due to;
(a) Intra band transition (b) inter band transition
(c) valence to conduction band transition (d) conduction to valence band transition

(6) The skin depth of a metal is the distance at which the amplitude of an electromagnetic wave equals to __________ of its value at the surface.
(a) e^{-1} (b) e^{+1} (c) e^{2} (d) e^{-2}

(7) The Orbach relaxation of dominant spin-lattice interaction in paramagnetic ions of crystal sample arises due to;
(a) scattering of a phonon (b) emission of a phonon
(c) intervention of a third state (d) absorption of a phonon

(8) The ferromagnetic resonance frequency for an ellipsoid sample is given as ______________. Where symbol has its usual meaning.
(a) $\gamma^2[B_0 + (N_y - N_z)M][B_0+(N_x - N_z)M]$ (b) γB_0
(c) $\gamma(B_0 - 4\pi M)$ (d) $\gamma[B_0(B_0 + 4\pi M)]^{1/2}$

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

(1) Radiationless transition is possible in phosphors? Justify it.
(2) Can Germanium and Silicon semiconductors be used as luminescent material? Why?
(3) Describe Gudden-Pohl effect in luminescent solid.
(4) Obtain the expression to calculate recoil energy in Mossbauer effect.

[P.T.O.]

(5) Calculate the recoil velocity of Mossbauer nucleus of mass 1.67×10^{-25} kg when emitting a gamma ray of wavelength 0.1 nm. What is the Doppler shift of gamma ray frequency?

(6) Explain absorption of energy in dielectric and dielectric loss.

(7) Write a brief on p-n junction photovoltaic cells.

(8) Write the three different ways of relaxation procedure in nuclear magnetic resonance.

(9) In ferromagnetic ordering discuss Curie point and mean field approximation.

Q.3(a) What is luminescence? Describe different types of the luminescence and also mention applications of it. [6]

Q.3(b) Explain excitation and absorption in luminescent material. Describe three different ways in which excitation is produced in this material. [6]

OR

Q.3(b) Why pure KCl crystal cannot exhibits luminescent properties? What are the effects of adding thallium activators in pure KCl crystal? Discuss its absorption and emission spectra using necessary diagram in detail. [6]

Q.4(a) What is Mossbauer effect? Using necessary diagram explain Mossbauer effect in detail and narrate its requirements. [6]

Q.4(b) What is resonance? Describe three attempts to observe the resonance fluorescence and also mention its conditions to observe resonance fluorescence. [6]

OR

Q.4(b) Obtain an expression of Debye-Waller factor used in Mossbauer spectroscopy and also show its temperature dependence. [6]

Q.5(a) What is photoconductivity? Derive the equation of response time and gain factor. Why calculated gain factor varies from the experimental gain factor. [6]

Q.5(b) Explain complex dielectric constant. Derive the equation of energy dissipated per second in dielectric material. Show how the energy loss is proportional to loss factor. [6]

OR

Q.5(b) In absorption process explain fundamental absorption. Explain direct and indirect gap semiconductor absorption. Also discuss exciton absorption. [6]

Q.6(a) What are magnons? Derive and discuss the dispersion relation of Magnons. [6]

Q.6(b) Taking magnetite Fe_3O_4 as an example, explain ferromagnetic order. [6]

OR

Q.6(b) Explain nuclear magnetic resonance (NMR) and obtain expression for free precession $\omega_o = \gamma B_o$. [6]

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