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10PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2013/Jan.2014
Engineering Physics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, choosing at least two from each part.***
2. ***Answer all objective type questions only on OMR sheet page 5 of the answer booklet.***
3. ***Answer to objective type questions on sheets other than OMR will not be valued.***
4. ***Physical constants :*** $h = 6.625\times10^{-34}$ ***J-S,*** $C = 3\times10^{8} mS^{-1}$, $m_e = 9.1\times10^{-31} kg$, $K = 1.38\times10^{-23} Fm^{-1}$, $\epsilon_0 = 8.854\times10^{-12} Fm^{-1}$.

PART – A

1 a. Choose the correct answers for the following : **(04 Marks)**

i) De Broglie wavelength of an electron accelerated through a potential of 60 V is,
A) 1.850 A° B) 1.584 A° C) 1.589 A° D) 1.570 A°

ii) The wavelength of maximum intensity is inversely proportional to the absolute temperature of the body emitting radiation. This is called,
A) Stefan's law B) Wein's displacement law
C) Rayleigh-Jean's law D) Plank's law

iii) Einstein's photoelectric equation is given by,
A) $E = \phi + (KE)_{max}$ B) $E = \phi - (KE)_{max}$ C) $\phi = E + (KE)_{max}$ D) $(KE)_{max} = E + \phi$

iv) Which of the following relations can be used to determine de Broglie wavelength associated with a particle?
A) $\frac{h}{\sqrt{2mE}}$ B) $\frac{h}{mV}$ C) $\frac{h}{\sqrt{2meV}}$ D) all of these

b. Explain Wein's law ad Rayleigh-Jean's law. Mention their drawbacks. **(06 Marks)**

c. Define phase velocity and group velocity. Derive a relation between the two. **(06 Marks)**

d. Calculate the wavelength associated with electrons whose sped is 0.01 part of the speed of light. **(04 Marks)**

2 a. Choose the correct answers for the following : **(04 Marks)**

i) For a particle in an infinite potential well in its 1st excited state, the probability of finding the particle at the center of box is,
A) 0 B) 0.25 C) 0.5 D) 0.1

ii) The Heisenberg's Uncertainty relation for position of a particle is given by,
A) $\Delta P_x \Delta x \geq \frac{h}{2}$ B) $\Delta P_x \Delta x \leq \frac{h}{4\pi}$ C) $\Delta P_x \Delta x \geq \frac{h}{4\pi}$ D) $\Delta P_x \Delta x \geq \frac{h}{\pi}$

iii) According to Max Born approximation $|\psi|^2$ represents,
A) Particle density B) Charge density C) Energy density D) Probability density

iv) Schrodinger's time independent wave equation is applicable for the particle with,
A) Constant energy B) Variable energy
C) Only constant potential energy D) All of these

b. Set up time independent Schrodinger wave equation. **(06 Marks)**

c. Explain Heisenberg's Uncertainty principle. Give its physical significance. **(06 Marks)**

d. An electron is bound in one dimensional infinite well of width 0.12 nm. Find the energy value and de Broglie wavelength in the first excited state. **(04 Marks)**

3 a. Choose the correct answers for the following : **(04 Marks)**

i) The motor specific heat of a gas at constant volume is given by,

A) $C_V = \frac{2R}{3}$ B) $C_V = \frac{3R}{2}$ C) $C_V = \frac{4R}{3}$ D) $C_V = \frac{3R}{4}$

ii) If the Fermi energy of silver is 5.5 eV, the Fermi velocity of conduction electron is,

A) 0.98×10^6 m/S B) 1.39×10^6 m/S C) 2.46×10^5 m/S D) None of these

iii) Matthiessen's rule is given by,

A) $\rho = \rho_{ph} - \rho_i$ B) $\rho = \frac{\rho_{ph}}{\rho_i}$ C) $\rho = \rho_{ph} + \rho_i$ D) $\rho = \frac{\rho_i}{\rho_{ph}}$

iv) The value of Fermi distribution function at T = 0 K is 1, under the condition,

A) $E = E_f$ B) $E > E_f$ C) $E >> E_f$ D) $E < E_f$

b. Explain failure of classical free electron theory. **(06 Marks)**

c. Explain the probability of occupation of various energy states by electron at T= 0 K and T > 0 K on the basis of Fermi factor. **(06 Marks)**

d. Find the temperature at which there is 1.0 % probability that a state with an energy 0.5 eV above Fermi energy will be occupied. **(04 Marks)**

4 a. Choose the correct answers for the following : **(04 Marks)**

i) Choose the correct relation,

A) $E = \epsilon_0 (\epsilon_r - 1)P$ B) $P = \epsilon_0 (\epsilon_r - 1)E$ C) $\epsilon_r = K - 1$ D) $D = \epsilon_0 (\epsilon_r - 1)E$

ii) For ferromagnetic substance, the Curie-Weiss law is given by,

A) $\chi = \frac{C}{T}$ B) $\chi = \frac{C}{(T-\theta)}$ C) $\chi = \frac{(T-\theta)}{C}$ D) $\chi = \frac{C}{(T+\theta)}$

iii) The only polarization mechanism at frequencies exceeding 10^{13} Hz is,

A) ionic B) electronic C) orientation D) space charge

iv) Sulphur is an elemental solid dielectric of atomic weight 32.07 and density 2.07×10^3 kgm^{-3}. The number of atoms per unit volume for Sulphur is,

A) 3.89×10^{28} /m^3 B) 3.89×10^{25} /m^3 C) 9.3×10^{24} /m^3 D) None of these

b. Derive an expression for internal field in case of one dimensional array of atoms in dielectric solid. **(08 Marks)**

c. Describe ferroelectrics. **(04 Marks)**

d. If a WaCl crystal is subjected to an electric field of 1000 V/m and the resulting polarization is 4.3×10^{-8} C/m^2, calculate the static dielectric constant of NaCl. **(04 Marks)**

PART – B

5 a. Choose the correct answers for the following : **(04 Marks)**

i) If n_1 is the number density of lower energy E_1 and n_2 is the number density of higher energy E_2, then $n_2 > n_1$ is called,

A) thick population B) inverted population

C) normal population D) no population

ii) The number of modes of standing waves in the resonant cavity of length 1 m, if He – We laser operating at wavelength of 6328 A° is,

A) 3.16×10^6 B) 1.58×10^6 C) 3.16×10^8 D) None of these

iii) Image is stored on a hologram in the form of,

A) interference pattern B) diffraction pattern

C) photograph D) none of these

iv) The relation between Einstein's coefficients A & B is,

A) $\frac{8\pi h\lambda^3}{C^3}$ B) $\frac{8\pi h^2 r^3}{C^3}$ C) $\frac{8\pi h r^3}{C^3}$ D) $\frac{8\pi h r^3}{C^2}$

5 b. Explain the process of spontaneous and stimulated emission. **(06 Marks)**

c. Describe the construction and working of semiconductor laser. **(06 Marks)**

d. A pulse laser has an average power output 1.5 mW per pulse and pulse duration is 20 ns. The number of photon emitted per pulse is estimated to be 1.047×10^8. Find the wavelength of the emitted laser. **(04 Marks)**

6 a. Choose the correct answers for the following : **(04 Marks)**

i) The variation of critical field H_c with temperature T is given by,

A) $H_c = H_O\left[1-\left(\frac{T}{T_C}\right)^2\right]$ B) $H_c = H_O\left[1+\left(\frac{T}{T_C}\right)^2\right]$

C) $H_c = H_O\left[1-\frac{T}{T_C}\right]$ D) $H_c = H_O\left[1+\frac{T}{T_C}\right]$

ii) The quantum of magnetic flux is given by,

A) $\frac{2h}{e}$ B) $\frac{h}{2e}$ C) $\frac{he}{2}$ D) $\frac{2\pi h}{e}$

iii) Fractional index change of optical fiber and refractive index of core are 0.00515 and 1.533 respectively. The cladding refractive index is,

A) 1.492 B) 1.525 C) 1.499 D) 1.511

iv) The attenuation of a fiber – optical cable is expressed in,

A) ohm / km B) watt / km C) decibel / km D) joule / km

b. Describe type – I and type – II superconductors. **(06 Marks)**

c. What is attenuation? Explain any two factors contributing to the fibre loss. **(06 Marks)**

d. The angle of acceptance of an optical fibre is 30° when kept in air. Find the angle of acceptance when it is in a medium of refractive index 1.33. **(04 Marks)**

7 a. Choose the correct answers for the following : **(04 Marks)**

i) The relation between atomic radius and lattice constant in FCC structure is,

A) $a = 2r$ B) $a = 2\sqrt{2}r$ C) $a = \frac{\sqrt{3}}{4}r$ D) $a = \frac{4r}{\sqrt{3}}$

ii) The crystal with lattices $a = b \neq c$ and angles $\alpha = \beta = \gamma = 90°$ represents,

A) cubic B) hexagonal C) orthorhombic D) tetragonal

iii) The number of atoms present in the unit cell of diamond cubic crystal structure is,

A) 2 B) 4 C) 8 D) 16

iv) Bragg's law is given by,

A) $2\sin\theta = n\lambda$ B) $2d\sin\theta = n\lambda$ C) $\frac{2dn}{\sin\theta} = \lambda$ D) $2n\lambda = \sin\theta$

b. Define (i) Coordination number (ii) Packing factor. Calculate the atomic packing factor for BCC structure. **(06 Marks)**

c. Sketch the $(1\ \bar{1}\ 2)$, $(1\ 1\ 0)$ and $(1\ 0\ 0)$ planes in a simple cubic unit cell. Explain the procedure for obtaining miller indices. **(06 Marks)**

d. The minimum order of Bragg's reflection occurs at an angle of 20° in the plane (2 1 2). Find the wavelength of X-rays if lattice constant is 3.615 A°. **(04 Marks)**

8 a. Choose the correct answers for the following : **(04 Marks)**

i) In a carbon nanotube the bond between the carbon atom is,
A) metalic B) ionic C) hydrogen D) covalent

ii) A constant testing of product without causing any damage is called,
A) minute testing B) destructive testing
C) non-destructive testing D) random testing

iii) Ultrasonic waves are sound waves having,
A) Velocity greater than 330 mS^{-1} B) Velocity less than 330 mS^{-1}
C) Frequency greater than 20 kHz D) Frequency less than 20 kHz

iv) Which of the procedure is not employed to detect the internal flows by a material,
A) Ultrasonic method B) Magnetic method
C) Alpha ray method D) Dynamic testing

b. Explain carbon nanotubes and its application by giving physical properties. **(08 Marks)**

c. What are ultrasonics? Explain with a diagram a method for measurement of velocity of ultrasonic waves in liquids. **(08 Marks)**

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