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06PHY12/22

First/Second Semester B.E. Degree Examination, Dec.09/Jan.10
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 in 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: Electron mass = 9.1×10^{-31}kg, Neutron mass = 1.675×10^{-27}kg, $h = 6.63\times10^{-34}$Js, $K = 1.38\times10^{-23}$J/K, $N_A = 6.025\times10^{23}$/mole, $\varepsilon_0 = 8.85\times10^{-12}$.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. i) Wien's law is deduced from Planck's radiation formula under the condition of
A) Very small wavelength and temperature B) Large wavelength and temperature
C) Small wavelength and high temperature D) Large wavelength and small temperature

ii) The Compton wavelength is given by
A) $\frac{h}{m_oC^2}$ B) $\frac{h^2}{m_oC^2}$ C) $\frac{h}{m_oC}$ D) $\frac{h^2}{2m_oC}$

iii) 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.

iv) If the group velocity of a particle is 3×10^6 m/s, its phase velocity is
A) 100 m/s B) 3×10^6 m/s C) 3×10^8 m/s D) 3×10^{10} m/s **(04 Marks)**

b. What is Planck's radiation law? Show how Wien's law and Rayleigh-Jean's law can be derived from it. **(06 Marks)**

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

d. A fast moving neutron is found to have a associated de Broglie wavelength of 2Å, find its kinetic energy and group velocity of the de Broglie waves. **(04 Marks)**

2 a. i) The normalization of wave function is always possible, if
A) $\int_{-\infty}^{\infty}\psi\psi^* dx = \text{infinite}$ B) $\int_{-\infty}^{+\infty}\psi\psi^* dx = \text{finite}$
C) $\int_{-\infty}^{+\infty}\psi\psi^* dx = 0$ D) All of these.

ii) Schrodinger's time independent equation is applicable for the particles with
A) Constant energy B) Variable energy
C) Only constant potential energy D) All of these.

iii) The ground state energy of an electron in an infinite well is 5.6 meV. If the width of the well is doubled, the ground state energy is
A) 9.92×10^{-23} J B) 4.48×10^{-22} J C) 2.24×10^{-22} J D) None of these.

iv) The wave function is acceptable wave function if it is
A) finite everywhere B) Continuous everywhere
C) Single valued everywhere D) All of these. **(04 Marks)**

b. State Heisenberg's uncertainty principle and discuss its physical significance. **(06 Marks)**

c. Solve the Schrodinger's wave equation for allowed energy values in case of a particle in a potential box. **(10 Marks)**

3 a. i) For ordinary metals, the resistivity versus temperature curve at T = 0,
A) has a positive intercept B) has a negative intercept
C) goes through the origin D) none of these.

ii) Which one of the following relation is correct for current density?
A) $J = neAV_d$ B) $J = \frac{neA}{V_d}$ C) $J = neV_d$ D) $J = \frac{1}{neV_d}$

iii) The value of Fermi distribution function at absolute zero (T = 0 K) is 1, under the condition
A) $E = E_F$ B) $E > E_F$ C) $E >> EF$ D) $E < E_F$

iv) 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. **(04 Marks)**

b. Describe how quantum free electron theory has been successful in overcoming the failures of classical free electron theory. **(06 Marks)**

c. What is Fermi energy? Discuss variation of Fermi factor with energy and temperature. **(06 Marks)**

d. Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K, in a material. **(04 Marks)**

4 a. i) What changes in the capacitance of a capacitor occurs if the dielectric material is removed?
A) Increases B) Decreases C) Remains same D) None of these.

ii) The relation between B, M and H is
A) $H = \mu_0(M + B)$ B) $M = \mu_0(H + B)$ C) $B = \mu_0(H + M)$ D) None of these.

iii) Sulphur is an elemental solid dielectric of atomic weight 32.07 and density $2.07\times10^3 kg/m^3$. The number of atoms per unit volume for sulphur is
A) $3.89\times10^{28}/m^3$ B) $3.89\times10^{25}/m^3$ C) $9.3\times10^{24}/m^3$ D) None of these.

iv) Which one of the following is necessarily the piezoelectric material?
A) Lead B) Mica C) Iron D) Quartz. **(04 Marks)**

b. What is meant by polarization mechanism in dielectrics? Discuss any three different polarization mechanisms in dielectrics and their frequency dependence. **(08 Marks)**

c. Describe hard and soft magnetic materials. **(04 Marks)**

d. An elemental solid dielectric material has polarisability 7×10^{-40} Fm^2. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material, if it has 3×10^{28} atoms/m^3. **(04 Marks)**

PART – B

5 a. i) The life time of an atom at the ordinary excited state is of the order of
A) few mili second B) few nano second C) few micro second D) Unlimited.

ii) The relation between Einstein's coefficients A and B is
A) $\frac{8\pi h\lambda^3}{c^3}$ B) $\frac{8\pi h^2\nu^3}{c^3}$ C) $\frac{8\pi h\nu^3}{c^3}$ D) $\frac{8\pi h\nu^3}{c^2}$

iii) The number of modes of standing waves in the resonant cavity of length 1m, if He-Ne laser operating at wavelength of 6328 Å is
A) 3.14×10^6 B) 1.58×10^6 C) 3.16×10^8 D) None of these.

5 a. iv) From a broken hologram which is 10% of the original, if reconstruction of image is being done, then
A) Only 10% of information of the object can be obtained
B) Complete information of the object is obtained
C) No information of the object can be obtained
D) None of these. **(04 Marks)**

b. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein coefficient. **(07 Marks)**

c. Describe the recording and reconstruction processes in holography, with the help of suitable diagrams. **(05 Marks)**

d. A ruby laser emits pulse of 20 ns duration with average power per pulse being 100kW. If the number of photons in each pulse is 6.981×10^{15}, calculate the wavelength of photons. **(04 Marks)**

6 a. i) In a single mode fibre, the diameter of the core is nearly equal to
A) 125 μm B) 100 μm C) 50 μm D) 10 μm

ii) The numerical aperture of an optical fibre is 0.2 when surrounded by air. The acceptance angle when the fibre is in water of refractive index 1.33 is
A) 8.21′ B) 8.65′ C) 0.11′ D) None of these.

iii) The loss of power by the optical signal through the optical fibre is mainly due to
A) Rayleigh scattering B) Raman scattering C) Wein's scattering D) All of these.

iv) When the type-I superconducting material is placed in an external magnetic field, it
A) attracts the magnetic lines B) enhances the magnetic field lines
C) repels the magnetic field lines D) does not influence magnetic field of lines **(04 Marks)**

b. Describe the point to point communication system, with the help of a block diagram. **(05 Marks)**

c. Discuss BCS theory of superconductor. Explain SQUID. **(07 Marks)**

d. An optical glass fibre of refractive index 1.50 is to be clad with another glass to ensure internal reflection that will contain light travelling within 5° of the fibre axis. What maximum index of refraction is allowed for the cladding? **(04 Marks)**

7 a. i) Which one of the following crystal is an example of monoclinic?
A) SnO_4 B) NaCl C) $CaSO_4$ D) $CuSO_4$

ii) In a simple cubic lattice the ratio $d_{100} : d_{110} : d_{111}$ is
A) 6 : 3 : 1 B) $\sqrt{3} : \sqrt{6} : 1$ C) $6 : 3 : \sqrt{2}$ D) $\sqrt{6} : \sqrt{3} : \sqrt{2}$

iii) Which one of the following Bravais lattices is not found in cubic crystal?
A) Simple cube B) Face centered C) Body centered D) Base centered.

iv) The packing fraction of diamond crystal structure is
A) 34% B) 52% C) 68% D) 74% **(04 Marks)**

b. Discuss the Bravais lattice and any five crystal systems with the help of illustrations. **(08 Marks)**

c. Define coordination number and packing factor. Calculate the packing factor for sc, fcc and bcc structures. **(08 Marks)**

8 a. i) Which one of these does not represent a type of carbon nano tube?
A) Arm chair B) Wavy C) Zig-zag D) Arch discharge.

ii) The bulk material reduced in two directions is known as
A) Quantum dot B) Quantum wire C) Film D) Reduced structure.

iii) The ultrasonic waves are produced by
A) Electromagnetic induction B) Electric tuning fork
C) Piezoelectric effect D) Inverse piezoelectric effect.

iv) Which of the procedures is not employed to detect the internal flaws of a material?
A) Ultrasonic method B) Magnetic method
C) Alpha ray method D) Dynamic testing **(04 Marks)**

b. Discuss the variation of density of states for different quantum structures. **(08 Marks)**

c. What is non-destructive testing? Explain with principle, how flaw in a solid can be detected by non-destructive method, using ultrasonics. **(08 Marks)**

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