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10PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2011

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 : $h = 6.625 \times 10^{-34}$ J-S, $c = 3 \times 10^{8}$ ms^{-1}, $m_e = 9.1 \times 10^{-31}$ kg, $k = 1.38 \times 10^{-23}$ JK^{-1}, $\epsilon_0 = 8.854 \times 10^{-12}$ Fm^{-1}.*

PART – A

1 a. Choose your answers for the following :

i) In Compton Effect, the wavelength of the x-rays scattered at an angle $\theta > 0$.
A) increases B) doesn't change C) decreases D) none of these

ii) K_e, K_p and K_α an respective kinetic energy of an $\bar{e}$, a proton and α - particle of same de-Broglie wavelength, then
A) $K_e > K_p > K_\alpha$ B) $K_e > K_p < K_\alpha$ C) $K_e < K_p < K_\alpha$ D) $K_e = K_p = K_\alpha$

iii) The heavier of the particles has smallest de-Broglie wave length when both of them.
A) move with same speed B) move with same momentum
C) move with same kinetic energy D) none of these

iv) Matter waves are not electromagnetic waves because
A) they move with variable velocity B) depend on charge
C) move with constant velocity D) none of these **(04 Marks)**

b. What are the basic postulates of quantum theory of radiations? Explain how Planck's overcome the drawbacks of Weins law and Rayliegh Jean's law. **(06 Marks)**

c. Define group and phase velocity. Derive the expression for de-Broglie wavelength using group velocity concept. **(06 Marks)**

d. Compute the de Broglie wavelength for a neutron moving with one tenth part of the velocity of light. **(04 Marks)**

2 a. Choose your answers for the following :

i) An electron is moving in a box of length a; if ψ_1 is the wave function at $x = \frac{a}{4}$ with $n = 1$ and ψ_2 at $x = a$ for $n = 2$, then $\frac{\psi_2}{\psi_1}$ is

A) $\frac{\sqrt{2}}{a}$ B) $\frac{\sqrt{a}}{2}$ C) 0 D) ∞

ii) 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

iii) To become a nuclear constituent, the K.R of $\bar{e}$ must be of the order of
A) 20 MeV B) 2 MeV C) 20eV D) zero

iv) An electron has a speed of 100 m/s accurate to 0.05%. The uncertainty in its position is
A) 0.01m B) 0.0115m C) 0.024m D) 0.04m
(04 Marks)

b. What is a wave function? Explain the properties of a wave function. **(04 Marks)**

c. Derive the expression for energy eigen value for an electron in potential well of infinite depth. **(06 Marks)**

d. A quantum particle confined to one-dimensional box of width 'a' is in its first exerted state. What is the probability of finding the particle over an interval of $\left(\frac{a}{2}\right)$ marked symmetrically at the centre of box. **(06 Marks)**

3 a. Choose your answers for the following :

i) If the mobility of $\bar{e}$ in a metal increases the resistivity

A) decreases B) increases C) remains constant D) none of these

ii) The temperature dependence of electrical resistivity of metal is

A) $\rho\alpha\frac{1}{T}$ B) $\rho\alpha\frac{1}{\sqrt{T}}$ C) $\rho\alpha\sqrt{T}$ D) $\rho\alpha T$

iii) Zero percentage probability is the probability for $\bar{e}$ to occupy the energy level above the Fermi energy level at T = 0k is

A) $E + E_F$ B) $E = E_F$ C) $E > E_F$ D) $E < E_F$

iv) If the Fermi energy of a metal is 1.4eV, the Fermi temperature of the metal is approximately

A) 1.6×10^3 k B) 1.6×10^4 k C) 1.6×10^5 k D) 1.6×10^6 k

(04 Marks)

b. Discuss the various drawbacks of classical free electron theory of metals. What are the assumptions made in Quantum theory to overcome the same? **(06 Marks)**

c. Explain density of states? Derive the expression for electrical conductivity in terms of mean collision time. **(06 Marks)**

d. The Fermi level potassium is 2.1eV. What are the energies for which the probabilities of occupancy at 300 K are 0.99 and 0.5? **(04 Marks)**

4 a. Choose your answers for the following :

i) For ferromagnetic substances, the Curie-Weise law is given by

A) $\psi = \frac{C}{T}$ B) $\psi = \frac{C}{T-\theta}$ C) $\psi = \frac{T-\theta}{C}$ D) $\frac{C}{T-\theta}$

ii) Clausius-Mossotti equation does not hold for

A) gasses B) liquids C) crystalline solids D) none of these

iii) The Ferro electric material losses spontaneous polarization at

A) room temperature B) 0 K C) T_CK D) 100 K

iv) In hysterisis, polarization

A) moves with the electric field B) lags behind electric filed

C) ahead to the electric field D) none of these. **(04 Marks)**

b. Explain the term internal field. Derive an expression for internal field in the case of one dimensional array of atoms in di-electric solids. **(07 Marks)**

c. Derive Clausius-Mossotti equation. **(04 Marks)**

d. Sulphur is elemental solid di-electric whose di-electric constant is 3.4. Calculate the electronic polarizability if its density is 2.07×10^3 kg/m^3 and atomic weight is 32.07. **(05 Marks)**

PART – B

5 a. Choose your answers for the following :

i) Wavelength of a laser beam can be used as a standard of

A) time B) temperature C) angle D) length

ii) Image is stored on a hologram in the form of

A) interference pattern B) diffraction pattern

C) photograph D) none of these

iii) Which event is likely to takes place, when a photon of energy equal to the difference in energy between two levels is incident in a system

A) absorption B) emission

C) absorption and emission D) none of these

iv) Quartz plates are fixed at the ends of the discharge tube in a He-Ne laser so that

A) there won't be leakage of gas

B) the tube can withstand high electric voltage

C) the loses light can pass out without any loss

D) the emergency light is polarized **(04 Marks)**

b. Explain the requisites and conditions of a laser system. **(05 Marks)**

c. Describe the principle and working of LIDAR used to measure pollutant in atmosphere. **(06 Marks)**

d. Find the member of mode of standing waves and their frequency separation in the resonant cavity of 1m length of He-Ne operating at a wavelength of 632.8nm. **(05 Marks)**

6 a. Choose your answers for the following :

i) The conductivity of a superconductor is

A) infinite B) zero C) finite D) none of these

ii) The relation between superconducting transition temperature (T_C) and atomic weight (μ) of isotope is

A) $T_C \alpha \mu$ B) $T_C \alpha \frac{1}{\mu}$ C) $T_C \alpha \sqrt{\mu}$ D) $T_C \alpha \frac{1}{\sqrt{\mu}}$

iii) If optic fibre is kept in a medium of R.I. μ (>1) instead of air, the acceptance angle

A) increases B) decreases C) remains constant D) none of these

iv) In graded index fibre, the R.I, of cladding varies

A) exponentially B) linearly C) parabolically D) none of these **(04 Marks)**

b. Discuss types of optical fibres and modes of propagation using suitable diagram. **(06 Marks)**

c. Distinguish between type- I and type – II superconductors. **(05 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 R.I. 1.33. **(05 Marks)**

7 a. Choose your answers for the following :

i) Four types of Bravais lattices are obtained in

A) rhombhohedral system B) orthorhombic system

C) triclinic system D) monoclinic system

ii) In BCC structure, the packing density of crystal is equal to

A) $\frac{\sqrt{3\pi}}{8}$ B) $\frac{\sqrt{3}\pi}{8}$ C) $\frac{3\pi}{8}$ D) $\frac{3\sqrt{3\pi}}{8}$

7 a. iii) Which of the following has greatest packing fraction

A) simple cubic B) body centred cubic

C) face centred cubic D) all have equal packing fraction

iv) The space lattice of diamond is

A) simple cubic

B) body centred cubic

C) face centred cubic with two atoms/unit cell

D) face centred cubic with four atoms/unit cell **(04 Marks)**

b. With a neat figure, explain the structure of diamond and show that atomic packing factor of diamond is 0.34. **(10 Marks)**

c. Calculate the glancing angle of the (110) plane of a simple cubic crystal ($a = 2.814\ \text{Å}$) corresponding to second order diffraction maximum for the x-rays of wavelength $0.710\ \text{Å}$. **(06 Marks)**

8 a. Choose your answers for the following :

i) The state of matter around the name – size is known as

A) solid state B) liquid state

C) plasma state D) mesoscopic state

ii) The ultrasonic waves are detected by

A) electromagnetic induction B) tuning fork

C) piezo electric effect D) inverse piezo electric effect

iii) A constant testing of product without causing any damage is called

A) minute testing B) destructive testing

C) non-destructive testing D) random testing

iv) The frequency of ultrasonic waves is

A) < 20 kHz B) between 20 Hz and 20 kHz

C) > 20 kHz D) none of these **(04 Marks)**

b. Describe a method for measurement of velocity of ultrasonic waves in a liquid and mention how the bulk modulus of the liquid could be evaluated. **(08 Marks)**

c. Write a note on carbon nano tube. Discuss the various quantum structures. **(08 Marks)**

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