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10PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Physics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, choosing at least two from each part.***

2. ***Physical constants: Velocity of light C = 3 × 10^8 m/s, Planck's constant h = 6.625 × 10^-34 JS, Electron charge e = 1.602 × 10^-19 C, Mass of electron, m_e = 9.11 × 10^-31 kg, Permitivity of vacuum ∈_0 = 8.85 × 10^-12 F/m Boltzmann constant, K = 1.38 × 10^-23 J/K***

PART – A

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

i) In Davisson and Germer experiment for an electron accelerated through a potential difference of 54 V, the constructive interference was observed at a scattering angle of,

A) 30° B) 50° C) 65° D) 90°

ii) De Broglie wavelength of an electron accelerated through a potential of 60 V is,

A) 1.85 A° B) 1.582 A° C) 1.782 A° D) 1.57 A°

iii) A proton and an α-particle has the same kinetic energy. If the mass of the α – particle if four times that of a proton, how are their de Broglie wavelengths compared?

A) $\lambda_p = \frac{\lambda_\alpha}{2}$ B) $\lambda_p = \frac{\lambda_\alpha}{4}$ C) $\lambda_p = 2\lambda_\alpha$ D) $\lambda_p = 4\lambda_\alpha$

iv) The phase velocity of matter wave is equal to,

A) $\frac{C}{V_g^2}$ B) CV_g^2 C) $\frac{C^2}{V_g}$ D) $\frac{V_g^2}{C}$

b. Explain Planck's radiation law. Show that how Planck's law could be reduced to Wien's law and Rayleigh-Jeans law. **(06 Marks)**

c. What are matter waves? Obtain an expression for group velocity of matter waves on the basis of superposition of waves. **(06 Marks)**

d. An electron initially at rest is accelerated through a potential difference of 100 V. Compute (i)The velocity of electron (ii) Phase velocity (iii) de Broglie wavelength of the electron. **(04 Marks)**

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

i) If free electron exists in a nucleus, it must have a minimum energy of about.

A) 20 KeV B) 10 KeV C) 4 MeV D) 20 MeV

ii) The energy of the n^{th} energy level in a one-dimensional potential box is,

A) $\frac{n^2h^2}{8a^2}$ B) $\frac{n^2h^2}{8a}$ C) $\frac{n^2h^2}{8m}$ D) $\frac{n^2h^2}{8ma^2}$

iii) For a particle in an infinite potential well in its first excited state, the probability of finding the particle is maximum at,

A) x = 0 B) x = a C) $x = \frac{a}{2}$ D) $x = \frac{a}{4}$ and $\frac{3a}{4}$

iv) According to max Born's approximation $|\psi^2|$ represents,

A) Probability density B) Charge density C) Particle density D) Energy density

b. Derive an expression for energy eigen value and eigen function for a particle in a potential well of infinite depth. **(07 Marks)**

c. What is a wave function? Explain the properties of wave function. **(05 Marks)**

d. An electron is bound in one-dimension potential well of width 2A° but of infinite height. Find its energy values in the ground state and also in first two excited state. **(04 Marks)**

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

i) The ideal resistivity in metals is due to scattering of electrons by,
A) Phonons B) impurities C) imperfections D) None of these

ii) In a metal, if the temperature increases then the resistivity,
A) increases B) remains same C) decreases D) None of these

iii) If the mobility of electron is $7\times10^{-3}\,m^2/Vs$ in a conductor, then the drift velocity of the electron in the conductor in a field of 1 V/cm is,
A) 0.7 m/s B) 7×10^{3} m/s C) 7×10^{2} m/s D) 0.007 m/s

iv) The value of Fermi distribution function at absolute zero is 0 under the condition,
A) $E = E_F$ B) $E > E_F$ C) $E << E_F$ D) $E < E_F$

b. Define drift velocity, relaxation time and mean collision time. Derive an expression for electrical conductivity on the basis of classical free electron theory of metals. **(07 Marks)**

c. Discuss Fermi-Dirac distribution at various temperature conditions. **(05 Marks)**

d. Calculate the mobility of electrons in copper assuming that each atom contributes one free electrons. Given resistivity of copper = $1.73\times10^{-8}\,\Omega m$, Atomic weight = 63.5, Density = $8.92\times10^{3}\,kg/m^3$, Avagadro's number, $N_A = 6.023\times10^{23}$ /mole. **(04 Marks)**

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

i) The range of frequency over which the ionic polarization is active is,
A) $1-10^{7}$ Hz B) $1-10^{12}$ Hz C) $1-10^{2}$ Hz D) None of these

ii) With increase in temperature, the orientation polarization,
A) decreases B) increases C) remains constant D) None of these

iii) Which of the following is not a piezoelectric material?
A) Quartz B) Rochelle salt C) PZT D) iron

iv) The magnetic susceptibility is negative for,
A) diamagnetic B) paramagnetic C) ferromagnetic D) none of these

b. Define internal field. Obtain an expression for internal field in case of one dimensional array of atoms in solids. **(08 Marks)**

c. Write a note on Ferro electric materials. **(05 Marks)**

d. The dielectric constant and the number of atoms per unit volume for sulphur are 3.4 and $3.89\times10^{28}/m^3$ respectively. Assuming a cubic lattice for its structure, calculate the electronic polarisability of sulphur. **(03 Marks)**

PART – B

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

i) The ratio of Einstein's co-efficients A and B is,
A) $\frac{8\pi h\gamma^3}{C^2}$ B) $\frac{8\pi h\lambda^3}{C^3}$ C) $\frac{8\pi h}{C^3}$ D) $\frac{8\pi h\gamma^3}{C^3}$

ii) In He-Ne laser, the ratio of Ne-He is in the order,
A) 1 : 10 B) 1 : 1 C) 10 : 1 D) 100 : 1

iii) In semiconductor laser, the material used is,
A) any semiconductor B) direct band gap semiconductor
C) Indirect band gap semiconductor D) not a semiconductor

iv) The optical effect made use of while recording a hologram is,
A) diffraction B) reflection C) interference D) polarization

b. Describe the construction and working of He-Ne laser with the help of energy level diagram. **(08 Marks)**

c. Describe the application of laser in welding giving its advantages over conventional welding. **(04 Marks)**

d. The ratio of population of two energy level is 1.059×10^{-30}. Find the wavelength of light emitted at 300 K. **(04 Marks)**

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

i) Optical fiber works on the principle of,
A) Interference B) Polarisation C) Total internal reflection D) None of these

ii) Attenuation means,
A) Amplification of signal strength B) Energy amplification
C) Loss of signal strength D) Tuning of signal

iii) Super conductor behaves as a perfect,
A) Paramagnet B) Ferromagnet C) Diamagnet D) Antiferromagnet

iv) Maglev works on the principle of,
A) Meissner effect B) Quantum interference
C) AC Josephson effect D) None of these

b. What is numerical aperture? Obtain the expression for the numerical aperture and arrive at the condition for propagation. **(07 Marks)**

c. Write a short note on superconducting magnets. **(05 Marks)**

d. Calculate the number of modes that can propagate inside an optical fiber, given $n_{core} = 1.53$, $n_{clad} = 1.5$, Core radius = 50 μm and λ = 1000 nm. **(04 Marks)**

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

i) Relation between atomic radius "R" and lattice constant "a" in f_{cc} structure is,
A) $a = 2R$ B) $a = 2\sqrt{2}R$ C) $a = \frac{8}{\sqrt{3}}R$ D) $a = \frac{4}{\sqrt{3}}R$

ii) The number of Bravais lattice in monoclinic system is,
A) 4 B) 1 C) 2 D) 3

iii) The Miller indices of the plane parallel to x and z axes are,
A) (1 0 0) B) (0 1 0) C) (1 1 1) D) (0 0 1)

iv) The packing factor for bcc structure is,
A) 0.34 B) 0.52 C) 0.68 D) 0.74

b. Explain in brief the seven crystal system with neat sketch. **(07 Marks)**

c. Describe the crystal structure of diamond and the co ordinates of atoms. **(05 Marks)**

d. Copper has a fcc structure of atomic radius 0.1278 nm. Calculate the interplanar spacing for (123) plane. **(04 Marks)**

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

i) The bulk material reduced by two dimension is known as,
A) Quantum wire B) Quantum dot C) a film D) none of these

ii) Which of these does not represent a type of carbon nanotube?
A) zig-zag B) Arm chair C) chiral D) arch discharge

iii) The frequency of ultrasonic wave is,
A) < 20 Hz B) between 20 Hz and 20 kHz C) >20 kHz D) None of these

iv) A constant testing of product without causing any damage is called,
A) Random testing B) Minute testing
C) Non-destructive testing D) Destructive testing

b. Explain in brief the application of nano technology. **(08 Marks)**

c. Describe a method of measuring velocity of ultrasonic waves in solids. **(08 Marks)**

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