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10PHY12/22

First/Second Semester B.E. Degree Examination, June/July 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 : Planck's constant h = 6.63 × 10^{-34} J-S , Electron charge e = 1.6 × 10^{-19} C, Electron mass m = 9.11 × 10^{-31} kg , Velocity of light C = 3 × 10^{8} m/s , Neutron mass = 1.675 × 10^{-27} kg , ϵ_0 = 8.85 × 10^{-12} F m^{-1} , K = 1.38 × 10^{-23} J/K***

PART - A

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

i) According to Wein's law, the wavelength of maximum intensity λ_m is

A) $\lambda_m \alpha T$ B) $\lambda_m \alpha \frac{1}{T}$ C) $\lambda_m \alpha T^4$ D) $\lambda_m \alpha \frac{1}{T^4}$

ii) de Broglie wave length of an electron accelerated by a potential of 100V is

A) 0.0012nm B) 0.1226 nm C) 1.226 nm D) 12.26 nm

iii) The wave nature associated with electrons in motion was verified by

A) Photoelectric effect B) Compton effect
C) Raman effect D) Diffraction by Crystals

iv) The momentum of a free particle carrying energy E and mass m is

A) 2mE B) $\sqrt{2mE}$ C) $2\sqrt{mE}$ D) m^2E^2.

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

c. What is Matter wave? Derive an expression for de – Broglie wavelength using group velocity concept. **(06 Marks)**

d. Find the energy of the neutron i.e eV whose de – Broglie wavelength is $1A^0$. **(04 Marks)**

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

i) The Product of Uncertainties between position and momentum is given by

A) $\Delta x \, \Delta p \geq \lambda$ B) $\Delta x \, \Delta p \geq \frac{h}{2}$ C) $\Delta x \, \Delta p \geq mv$ D) $\Delta x \Delta p \geq \frac{h}{4\pi}$

ii) The probability of locating a particle is maximum

A) within the wave packet B) at the nodes of the wave packet
C) cannot be determined D) none of these

iii) The energy corresponding to the first permitted energy level for a particle in an infinite potential well is called

A) excited state B) zero point energy
C) meta stable state energy D) none of these

iv) If an electron moves in one dimensional box of length 2nm, the normalization constant is

A) $1(nm)^{-1}$ B) $2(nm)^{-1}$ C) $\sqrt{2}(nm)^{-1}$ D) zero

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

c. Show that electrons cannot exist in the nucleus of an atom. **(06 Marks)**

d. An electron is bound in one dimensional box of width 0.16nm. Find the energy values in the ground state and first excited state. **(04 Marks)**

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

i) Specific heat of 1 mole of electron gas under constant volume is

A) $\frac{3}{5}$ R B) $\frac{R}{2}$ C) 3R D) $\frac{3}{2}$ R

ii) The expression of electrical resistivity P is

A) $\frac{ne^2\tau}{m}$ B) $\frac{m}{ne^2\tau}$ C) $\sqrt{\frac{ne^2\tau}{m}}$ D) $\sqrt{\frac{m}{ne^2\tau}}$

iii) The fermi factor for $E = E_f$ at $T > 0$ K is

A) 1 B) $\frac{1}{2}$ C) 0 D) 2

iv) According to quantum free electron theory, the energy levels in metal are

A) continuous B) discrete C) overlapping D) none

b. Using the free electron theory, derive an expression for electrical conductivity in metals. **(06 Marks)**

c. Discuss the probability of occupation of various energy states by electron by $T = 0^0$K and $T > 0^0$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 0.5eV above fermi energy will be occupied. **(04 Marks)**

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

i) Electronic Polarization

A) Independent of temperature B) Increases with temperature

C) Decreases with temperature D) None of these

ii) For Ferromagnetic substance, the Curie – Weiss law is given by

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

iii) The Polarisation that occurs in the frequency range $10^{12}H_2$ 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 kg/m^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. What is Internal field? Derive an expression for internal field in case of one dimensional array of atoms in dielectric solids. **(08 Marks)**

c. Write note on Ferroelectrics. **(04 Marks)**

d. An elemented solid dielectric material has Polarizability 7×10^{-40} F – m^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. Choose the correct answers for the following : **(04 Marks)**

i) The Pumping action in diode laser is by

A) Optical pumping B) Electric discharge

C) Reverse bias D) Forward bias

ii) The distribution of number of atoms is different discrete energy states is governed by

A) Fermi – Dirac distribution B) Maxwell – Boltzmann distribution

C) Bose – Einstein distribution D) None of these

iii) The life time of the meta stable is about _____ sec

A) 10^{-3} B) 10^{-13} C) 10^2 D) 10^{-9}

iv) Image is stored on a hologram in the form of
A) Interference pattern B) Diffraction pattern
C) Photography D) None of these

b. Explain the terms spontaneous emission and stimulated emission. **(04 Marks)**

c. Describe the construction of He – Ne laser and explain its working, with the help of suitable diagrams. **(08 Marks)**

d. A pulse laser has an average power output 1.5mw per pulse and pulse duration is 20ns. The number of photons 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 superconductor behaves like a Perfect
A) Paramagnet B) Ferro magnet C) Diamagnet D) None of these

ii) The critical temperature of mercury is
A) 4.2 K B) 2.4 K C) 6.2 K D) 7.8 K

iii) The quantum of magnetic flux is given by
A) $\frac{2h}{e}$ B) $\frac{h}{2e}$ C) $\frac{h}{2\pi e}$ D) $\frac{2\pi h}{e}$

iv) The attenuation of a fiber – optic cable is expressed in
A) ohm/km B) watt/km C) decibel/km D) joule/km

b. Define Super conductivity and explain Type – I and Type – II super conductors. **(06 Marks)**

c. Describe different types of optical fibres, with neat diagrams. **(06 Marks)**

d. The attenuation of light in an optical fiber is 3.6 dB/km. What fractional initial intensity remains after 1km? **(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) $a = \frac{\sqrt{3}\,r}{4}$ D) $a = \frac{4r}{\sqrt{3}}$

ii) Which of the following crystal structure is having the least coordination number?
A) Simple cubic B) Body centered cubic
C) Face centered cubic D) None of these

iii) The inter planar spacing in a crystal is $1A^0$ and the glancing angle is 35^0. For the first order Bragg reflection to take place, the wavelength of X – rays is
A) $1.147A^0$ B) $0.573A^0$ C) $1.638A^0$ D) $0.819A^0$

iv) The inter atomic distance between the sodium and chlorine atoms in sodium crystal is
A) $5.51A^0$ B) $5.62A^0$ C) $6.62A^0$ D) $2.81A^0$

b. Derive Bragg's law for X – ray diffraction in crystals. **(04 Marks)**

c. Define Coordination number and atomic packing factor. Calculate the packing factor for SC, BCC and FCC structures. **(08 Marks)**

d. Copper has FCC structure and the atomic radius is 0.1278nm. Calculate the inter planor spacing for (111) and (321) planes. **(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) The 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

iii) The ultrasonic waves are produced by
A) Electromagnetic induction B) Electric tuning fork
C) piezo electric effect D) Inverse piezo electric effect

iv) A constant testing of product without causing any damage is called
A) minute testing B) destructive testing
C) non – destructive testing D) random testing

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

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

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