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10PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2019/Jan.2020
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: $h = 6.625\times10^{34}$ J-S, $m^e = 9.11\times10^{-31}$ Kg, $c = 3\times10^8$ m/sec, $k = 1.38\times10^{-23}$ J K^{-1}, $\epsilon_0 = 8.854\times10^{-12}$ F/m***

PART – A

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

i) The law which failed to account for longer wavelength of the black body spectrum is
A) Wien's law B) Rayleigh – Jeans Law
C) Planck' law D) Stefan's Law

ii) In Davisson and Germer experiment the exact value of voltage V and scattering angle ϕ at which ionization current becomes maximum is
A) $V = 50V, \phi = 54°$ B) $V = 50V, \phi = 65°$
C) $V = 40V, \phi = 50°$ D) $V = 54V, \phi = 50°$

iii) Group velocity V_g and phase velocity V_p are related by
A) $V_p \times V = C^2$ B) $V_g \times V_p = C^2$ C) $V_p \times V_g = C$ D) $V_g \times V_p = V^2$

iv) Relation between Kinetic energy 'E' and de-Broglie wavelength 'λ' of a particle of mass 'm' is given by
A) $\lambda = \frac{h}{2mE}$ B) $\lambda = \frac{h}{\sqrt{2m\ eE}}$ C) $\lambda = \frac{h}{\sqrt{2mE}}$ D) $\frac{1.226}{\sqrt{V}}$ Å

b. State and explain De-Broglie's hypothesis. Explain any four characteristics properties of matter waves. **(06 Marks)**

c. Explain briefly phase velocity and group velocity. Derive the relation between them in terms of wavelength 'λ' **(06 Marks)**

d. Calculate the Compton shift when a beam of monochromatic x-rays of wavelength 1.242 Å is viewed at an angle of 60° to the direction of incidence. **(04 Marks)**

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

i) According to Heisenberg uncertainty principle, the uncertainty in the measurement of energy and time is given by
A) $\Delta E\cdot\Delta t \geq \frac{4\pi}{h}$ B) $\Delta x\,\Delta p = \frac{h}{4\pi}$ C) $\Delta x\,\Delta p \geq h$ D) $\Delta E\cdot\Delta t \geq \frac{h}{4\pi}$

ii) According to Max-Born interpretation $|\psi|^2$ of the wave function represents
A) Particle density B) Energy density C) Probability density D) Charge density.

iii) The normalization of a wave function 'ψ' of a particle in the given space dv is given by
A) $\int_{-\infty}^{0}|\psi|\,dv = 1$ B) $\int_{0}^{\infty}|\psi|^2\,dv = 1$ C) $\int_{-\infty}^{+\infty}|\psi|^2\,dv = 1$ D) $\int_{0}^{-\infty}|\psi|\,dv = 0$

iv) The zero point energy of an electron in a potential well of infinite depth is given by
A) Zero B) $m^2/8hL^2$ C) $h^2/8mL^2$ D) $\frac{8mL^2}{nh^2}$

b. Write any two properties and physical significance of wave function 'ψ' **(04 Marks)**

c. Using Schrödinger time independent wave equations derive an expression for energy eigen values of a particle in a potential well of infinite depth and discuss the solution. **(08 Marks)**

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.

d. Calculate the energy required to excite an electron from its ground state to fifth excited state where it is trapped in a one – dimensional box of 1 Å length. **(04 Marks)**

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

i) Classical free electron theory failed to explain
A) specific heat of metal B) mean free path
C) Temperature dependence of conductivity D) All the above.

ii) The time elapsed between two successive collision is
A) Collision time B) Relaxation time C) Mean time D) Mean free path.

iii) If potential of 5V is applied for conductors of length 1m and 2m then the ratio of the electric fields in the conductors (E_1/E_2) is
A) 1 B) 4 C) 2 D) 1/2

iv) The sum of the probability of occupancy of energy of the occupied states above and below the Fermi level is
A) 0 B) 1 C) -1 D) ∞

b. Explain briefly the various drawbacks of classical free electron theory of metal and discuss the assumption made in quantum theory to overcome the drawbacks. **(08 Marks)**

c. Explain Fermi energy and Fermi factor. **(04 Marks)**

d. The mean 'free-time between the collision of electron is 10^{-13}sec. Calculate the mobility of electrons. **(04 Marks)**

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

i) Some crystalline solids exhibits the properties of "electric polarization when strained elastically this is known as
A) Ferroelectric effect B) loss angle
C) piezoelectric effect D) Hysterisis.

ii) The ratio of magnetic induction 'B' to the magnetic intensity 'H' is known as
A) Magnetic susceptibility B) Magnetic moment density
C) Magnetic permeability D) Low hysteresis energy loss.

iii) Hard magnetic material are characterized by
A) Low retentivity and Low coercivity B) High retentivity and high coercivity
C) High permeability D) High susceptibility.

iv) The Area enclosed by the hysteresis loop is a measure of
A) Susceptibility B) Permeability C) Energy loss per cycle D) retentivity

b. Explain briefly Ferro-electricity and Piezo-electricity. **(04 Marks)**

c. Explain the term "internal field". Derive an expression for the internal field in case of one dimensional array of atoms in dielectric solids. **(09 Marks)**

d. The dielectric constant of sodium chloride is 6. Calculate the polarization produced when it is subjected to a field of 560 V/mm. **(03 Marks)**

PART – B

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

i) The process in which an incident photon forces the excited atom to emit another photon of the same frequency, direction and phase can be done by
A) Induced absorption B) Spontaneous emission
C) Stimulated emission D) Population inversion.

ii) The characteristics of Laser – beam are
A) Completely spatially coherent B) Perfectly monochromatic
C) Extremely intense D) All the above.

iii) Main element of semiconductor laser is
A) Helium Neon B) Gallium Arsenide C) Chromium D) Aluminium.

iv) Principle of Holography in any plane is due to the recording of
A) Intensity distribution B) Phase distribution
C) Both intensity and phase distribution D) None of the above.

b. With a neat energy level diagram, explain the construction and working of He-Ne gas laser **(07 Marks)**

c. Explain briefly the laser welding, Laser cutting, and laser drilling with figures. **(05 Marks)**

d. A Helium-Neon gas laser emits of light of wavelength 632.8nm an has an output source of 3.14mW. How many photons are emitted in each second by the laser? **(04 Marks)**

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

i) The "perfect diamagnetism" of the material in the superconducting state is demonstrated by
A) Zeeman effect B) Meissner effect C) BCS theory D) Phonon theory.

ii) The relation between critical magnetic field H_c and the critical temperature T_c of the superconductor is given by

A) $T = T_c\left(1 - \frac{H}{H_c}\right)$ B) $H_c = H_0\left(1 - \frac{T}{T_c}\right)^2$

C) $T_c = T(H_c - H_0)$ D) $H_c = H_0\left[\frac{1-T^2}{T_c^2}\right]$

iii) If the Refractive index of air, core and cladding are n_0, n_2 and n_1 respectively then
A) $n_0 > n_1 > n_2$ B) $n_1 > n_2 > n_0$ C) $n_2 > n_1 > n_0$ D) $n_1 > n_0 > n_2$

iv) The numerical aperture of an optical fibre when it is surrounded by air, having Refractive index of core is 1.54 and cladding 1.50 is ______
A) 0.350 B) 23° C) 0.5 D) 30°

b. With neat diagram, explain three types of optical fibre and modes of propagation. **(08 Marks)**

c. What are the advantages of the optical fibre communication system over the conventional communication system? **(04 Marks)**

d. The refractive index of the core of an optical fibre is 1.532 and its fractional index change is 0.00514. Calculate the refractive index of cladding. **(04 Marks)**

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

i) In the cubic crystal structure, the angle α, β and γ must be
A) $\alpha = \beta = 90°, \gamma = 120°$ B) $\alpha = \beta = \gamma = 90°$
C) $\alpha = \beta = \gamma \neq 0$ D) $\alpha \neq \beta \neq \gamma \neq 90°$

ii) The co-ordination number of fcc structure is
A) 12 B) 6 C) 8 D) 10

iii) The Atomic packing factor (PF) for bcc structure is
A) 0.74 B) 0.52 C) 0.68 D) 0.45

iv) For every rotation 'θ; of the Bragg's spectrometer's the detector must turn by an angle of
A) θ B) 3θ C) 2θ D) 4θ

b. Explain the procedure followed to specify the crystal planes using Miller indices. Give an example. **(04 Marks)**

c. Explain how Bragg's spectrometer is used to determine the interplaner spacing in the crystal. **(08 Marks)**

d. Copper has fcc structure of atomic radius 0.127nm. Calculate the interplaner spacing (3 2 1) plane. **(04 Marks)**

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

i) The state of matter around the nano size is known is
A) Solid state B) Liquid state C) Plasma state D) Mesoscopic state.

ii) Bulk material reduced in three dimensions is known as
A) Quantum Dot B) Quantum wire C) Film D) Quantum particles.

iii) Ultrasonic are ______
A) X-rays B) Electromagnetic waves
C) Longitudinal waves D) Non-mechanical waves.

iv) The elastic behavior of a liquid is characterized by its ____
A) Young's modulus B) Modulus of rigidity
C) Bulk modulus D) Poisson's ratio.

b. Describe a method of measuring velocity of ultrasonic waves in a liquid. **(08 Marks)**

c. Explain the carbon nano-tube. Mention its properties and four applications. **(08 Marks)**

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