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10PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2017
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: $h = 6.625 \times 10^{-34}$ J-s, $C = 3 \times 10^8$ ms⁻¹, $m_e = 9.1 \times 10^{-31}$ kg, $L = 1.38 \times 10^{-23}$ Fm⁻¹,
 $\epsilon_0 = 8.854 \times 10^{-12}$ Fm⁻¹, $e = 1.6 \times 10^{-19}$ C, Avogadro number $N_A = 6.025 \times 10^{26}$ /K mole.

PART – A

- 1 a. Choose the correct answers for the following :
- The associated wavelength of an electron beam is acceleration from rest through a potential difference of 200V is
 A) 0.868 Å B) 0.0868 Å C) 0.969 Å D) 0.0969 Å
 - In blackbody radiation spectrum, with increase of temperature the maximum intensity position shift towards.
 A) Shorter wavelength B) longer wavelength
 C) Entire wavelength D) no change.
 - Davisson and Germer succeeded in their experiment in proving
 A) Bragg's law B) Particle nature of electrons
 C) Wave nature of electrons D) That nickel is a crystal
 - Einstein's photo electric equation is given by
 A) $\frac{1}{2} mV_{\max}^2 = h\nu - \phi$ B) $\frac{1}{2} mV_{\max}^2 = h\nu + \phi$ C) $\frac{1}{2} mV_{\max}^2 = h\nu - h_1$ D) None of these
 (04 Marks)
- b. What is Planck's radiation law? Show that Planck's law reduces to Wien's law and Rayleigh Jeans law. (06 Marks)
- c. Define phase velocity and group velocity and derive a relation between them. (06 Marks)
- d. Estimate the potential difference through which a proton is needed to be accelerated so that its de Broglie wavelength becomes equal to 1 Å, given mass of proton is 1.673×10^{-27} kg. (04 Marks)
- 2 a. Choose the correct answers for the following :
- The energy required for an electron to jump from ground state to the second excited state in a potential well of width L is
 A) $E = \frac{h^2}{mL^2}$ B) $E = \frac{h^2}{4mL^2}$ C) $E = \frac{h^2}{8mL^2}$ D) $\frac{2h^2}{mL^2}$
 - According to max Born's interpretation, $|\psi|^2$ represents
 A) probability density B) Energy density
 C) Particle density D) Charge density.
 - A wave function is an acceptable wave function if it is
 A) Finite every where B) Continuous every where
 C) Single valued every where D) All of these.
 - If the uncertainty in momentum is large, the uncertainty in wavelength is
 A) Small B) Large C) Zero D) None of these
 (04 Marks)

- b. Obtain the time independent Schrödinger wave equation, in one dimension. (07 Marks)
- c. State and explain Heisenberg's uncertainty principle. (04 Marks)
- d. An electron and a 150×10^{-3} Kg base ball are travelling at a velocity of 220m/s, measured to an accuracy of 0.005%. Calculate uncertainty in position of each. (05 Marks)
- 3 a. Choose the correct answers for the following :
- i) The free electrons in classical free electron theory are treated as
 A) rigidly fixed lattice points B) Gas molecules
 C) Liquid molecules D) None of these.
- ii) The electron mobility in a solid is
 A) $\mu = \frac{V_d}{E}$ B) $\mu = V_d E$ C) $\mu = \frac{V_d}{L}$ D) $\mu = V_d L$
- iii) The Fermienergy of a metal at absolute zero temperature is proportional to
 A) $n^{1/3}$ B) $n^{3/2}$ C) $n^{2/3}$ D) n^2
- iv) The collision time and root mean square velocity of an electron at room temperature are 3×10^{-14} s and 1×10^5 m/s respectively. The classical value of mean free path of the electron is
 A) 3×10^{-19} m B) 3×10^{-10} m C) 3×10^{-9} m D) 3×10^{19} s (04 Marks)
- b. Using the free electron theory, derive an expression for electrical conductivity in metals. (06 Marks)
- c. Discuss the dependence of Fermic factor on temperature. (06 Marks)
- d. Calculate the Fermienergy of sodium at 0K assuming that it has one free electron per atom and density of sodium is 970 kg/m^3 and atomic weight 23. (04 Marks)
- 4 a. Choose the correct answers for the following :
- i) If the radius of hydrogen atom is 0.053×10^{-9} m, then its electronic polarizability is
 A) $1.656 \times 10^{-41} \text{ Fm}^2$ B) $3.035 \times 10^{-40} \text{ Fm}^2$ C) $5.9 \times 10^{-21} \text{ Fm}^2$ D) $16.56 \times 10^{-41} \text{ Fm}^2$
- ii) The polarization mechanism that depends on temperature is
 A) Electronic B) ionic C) orientational D) Space charge
- iii) The relative permeability for diamagnetic materials is
 A) > 1 B) < 1 C) $= 1$ D) Zero
- iv) Piezoelectric effect is used to convert ____ energy into ____ energy.
 A) Mechanical, electrical B) Electrical, mechanical
 C) Electrical, light D) None of these. (04 Marks)
- b. Define dielectric polarization. Discuss different types of polarization mechanics. (07 Marks)
- c. Compare soft and hard magnetic materials on the basis of hysteresis curve, Give example and applications for each type. (05 Marks)
- d. The dielectric constant of sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of sulphur. The atomic weight and density of sulphur are 32.0 and $2.07 \times 10^3 \text{ kg/m}^3$ respectively. (04 Marks)

PART – B

- 5 a. Choose the correct answers for the following :
- i) The ratio of Einstein's spontaneous and stimulated emission coefficients is
 A) $\frac{8\pi h \lambda^3}{C^3}$ B) $\frac{8\pi h \gamma^3}{C^3}$ C) $\frac{8\pi h \gamma^2}{C^2}$ D) $\frac{8\pi h \lambda^2}{C^2}$
- ii) The process of producing population inversion is known as
 A) absorption B) emission C) pumping D) None of these

- iii) Active centre of He-Ne gas loses
 A) Ne B) He C) Both Ne and He D) None
- iv) Image is stored on a hologram in the form of
 A) interference pattern B) diffraction pattern
 C) polarization D) photography (04 Marks)
- Describe the construction and working of He-Ne laser. (07 Marks)
- b. What is holography? Explain the recording process in holography. (05 Marks)
- c. A He-Ne laser emits photons of wavelength 632.8nm with 1mW average power per pulse.
- d. Calculate the number of photons emitted per second. (04 Marks)
- 6 a. Choose the correct answers for the following :
- i) In an Optical fibre, the core material has refractive index 1.43 and refractive index of clad material is 1.4, the numerical operator is
 A) 0.92 B) 0.29 C) 0.97 D) 0.77
- ii) The relation between numerical aperture and fractional index change is
 A) $NA = n_1\sqrt{2\Delta}$ B) $NA = \Delta\sqrt{2n_1}$ C) $NA = \Delta n_1\sqrt{2n_1}$ D) $NA = 2n_1\sqrt{\Delta}$
- iii) The variation of critical field H_c with temperature T is given by
 A) $H_c = H_0 \left[1 - \left(\frac{T}{T_c} \right)^2 \right]$ B) $H_c = H_0 \left[1 + \left(\frac{T}{T_c} \right)^2 \right]$
 C) $H_c = H_0 \left[1 - \left(\frac{T}{T_c} \right) \right]$ D) $H_c = H_0 \left[1 + \left(\frac{T}{T_c} \right) \right]$
- iv) Superconductors in superconducting state behaves as
 A) Ferromagnetic material B) Diamagnetic materials
 C) Dielectric material D) Monovalent material. (04 Marks)
- b. Discuss the different types of optical fibres with suitable diagrams. (06 Marks)
- c. Define superconductivity and explain Type I and Type II superconductors. (06 Marks)
- d. A step index optical fibre has a core index of 1.46 and the cladding index of 1.409. If the core diameter is $80\mu\text{m}$, and the wavelength of light source is $1.2\mu\text{m}$, determine the number of modes present in the fibre. (04 Marks)
- 7 a. Choose the correct answers for the following :
- i) Lead exhibits FCC structure. Each side of the unit cell is of 4.95 \AA , the radius of a lead atom is
 A) 1.75 \AA B) 1.57 \AA C) 1.075 \AA D) 1.057 \AA
- ii) The miller indices of the plane parallel to X and Y axes are
 A) (100) B) (010) C) (001) D) (111)
- iii) The lattice constant of a cubic crystal is given by
 A) $a = d_{hkl} \sqrt{h^2 + k^2 + \ell^2}$ B) $a = \frac{d_{hkl}}{\sqrt{h^2 + k^2 + \ell^2}}$
 C) $a = \frac{\sqrt{h^2 + k^2 + \ell^2}}{d_{hkl}}$ D) None of these.
- iv) The grating space of calcite is 3.036 \AA . The wavelength of X-rays that undergo first order reflection at a glancing angle of 12° is
 A) 1.262 \AA B) 1.626 \AA C) 1.541 \AA D) 1.145 \AA (04 Marks)

- b. What are miller indices? Explain procedure to find miller indices with an example. (05 Marks)
- c. Describe how Bragg's X-ray spectrometer is used to determine the wavelength of an X-ray beam. (06 Marks)
- d. Monochromatic X-rays of wavelength 0.82 \AA undergo first order Bragg reflection from a crystal of cubic lattice with lattice constant 3 \AA , at a glancing angle of 7.855° . Identify the possible planes which give rise to this reflection in terms of their miller indices. (05 Marks)
- 8 a. Choose the correct answers for the following :
- i) The nanostructure reduced in only one direction is known as
 A) quantum dot B) Quantum wire C) film D) Quantum well
- ii) The signal due to a reflected wave is called
 A) transmitted wave B) longitudinal wave C) echo D) peaco
- iii) The elastic behavior of a liquid is characterized by its
 A) Young's modulus B) Bulk modulus
 C) Rigidity modulus D) Poisson's ratio
- iv) An acoustic grating can be made by
 A) Setting up a standing wave pattern in a liquid using ultrasonic's
 B) Subjecting an optical grating to pressure waves of ultrasonic frequency.
 C) Drawing lines on a glass plate at equal width
 D) It is only a theoretical concept. (04 Marks)
- b. Write a note on nanotechnology. (04 Marks)
- c. Write a note on fullerene with applications. (06 Marks)
- d. Describe a method of measuring velocity of ultrasonic waves in a liquid. (06 Marks)

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