First Semester B.E. Degree Examination, January 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) 　Green light incident on a surface releases photoelectrons from the surface. If now blue light is incident on the same surface, the velocity of electrons
　　　　A) increases 　　　B) decreases 　　　C) remains same 　　　D) becomes zero
　　ii)　Rayleigh-Jean's theory of radiations agree with experimental results for
　　　　A) all wavelengths 　　　　　　　　　B) shorter wavelengths only
　　　　C) longer wavelengths only 　　　　　D) middle order wavelengths only
　　iii)　The de-Broglie wavelength of an electron accelerated to a potential difference of 100 volts is
　　　　A) 1.2 Å 　　　B) 10 Å 　　　C) 100 Å 　　　D) 12 Å
　　iv)　The wave nature associated with electrons in motion was verified by
　　　　A) photoelectric effect 　　　　　　　B) compton effect
　　　　C) diffraction by crystals 　　　　　　D) Ramon effect 　　　　　　**(04 Marks)**
　　b.　State and explain de-Broglie's hypothesis. 　　　　　　　　　　　　**(04 Marks)**
　　c.　Define phase velocity and group velocity. Obtain the relation between group velocity and particle velocity. Obtain the expression for de-Broglie wavelength using group velocity.
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(08 Marks)
　　d.　Find the kinetic energy and group velocity of an electron with de-Broglie wavelength of 0.2 nm. 　　　　　　　　　　　　　　　　　　　　　　　　　　**(04 Marks)**

2　a.　Choose your answers for the following :
　　i)　The uncertainty in the determination of position of an electron is $\left(\frac{h}{3\pi}\right)$. Then, the uncertainty in the determination of its momentum is
　　　　A) ¾ 　　　B) ¼ 　　　C) ⅔ 　　　D) 3
　　ii)　The probability of locating a particle is maximum
　　　　A) at the centre of the wave packet 　　　B) at the nodes of the wave packet
　　　　C) cannot be determined 　　　　　　　　D) none of these
　　iii)　In Davision and Germer experiment, when 54 volts was applied to electrons, the pronounced scattering direction was found to be at
　　　　A) 90° 　　　B) 120° 　　　C) 50° 　　　D) none of these
　　iv)　The ground state energy of an electron in an one dimensional infinite potential well of width 2 Å is 16 eV. Its energy in third excited state is
　　　　A) 32 eV 　　　B) 64 eV 　　　C) 144 eV 　　　D) 256 eV
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(04 Marks)

2 b. State and explain Heisenberg's uncertainty principle. **(04 Marks)**

c. Find the eigen value and eigen functions for an electron in one dimensional potential well of infinite height. **(08 Marks)**

d. Estimate the time spent by an atom in the excited state during the excitation and de-excitation processes, when a spectral line of wavelength 546 nm and width 10^{-14} m is emitted. **(04 Marks)**

3 a. Choose your answers for the following :

i) The mobility of electrons in a conductor is 4×10^{-3} $m^2V^{-1}s^{-1}$. Then the drift velocity of the electron in the presence of applied electric field of strength 100 Vm^{-1} is

A) 4 ms^{-1} B) 10 ms^{-1} C) 0.4 ms^{-1} D) 0.04 ms^{-1}

ii) The classical value of molar specific heat of a conductor is

A) $\frac{3}{2}$ R   B) $\frac{1}{2}$ R   C) 3 R   D) $\frac{5}{2}$ R

iii) The Fermi energy 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

where 'n' is number of free electrons per unit volume.

iv) At 50 K, the probability of finding an electron at Fermi energy is $\frac{1}{2}$. The probability of finding electron at the same energy level at 100 K is

A) 1   B) zero   C) $\frac{1}{4}$ D) $\frac{1}{2}$ **(04 Marks)**

b. Obtain the expression for electrical conductivity on the basis of free electron theory of metals. **(08 Marks)**

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

d. Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level and 0.02 eV below the Fermi level at 200 K. **(04 Marks)**

4 a. Choose your answers for the following :

i) Choose the correct relation :

A) $E = \epsilon_0 (\epsilon_r - 1)P$ B) $D = \epsilon_0 (\epsilon_r - 1)E$ C) $P = \epsilon_0 (\epsilon_r - 1)E$ D) $\epsilon_r = \chi - 1$

ii) Electronic polarization

A) decreases with increase in temperature

B) increases with temperature

C) is independent of temperature

D) may increase or decrease with temperature

iii) Hysteresis loss occurs when the mag material is subjected to

A) DC voltage   B) AC voltage

C) both AC and DC voltage   D) none of these

iv) The relative permeability for diamagnetic materials is

A) slightly greater than one   B) zero

C) less than one   D) very much greater than one **(04 Marks)**

b. Obtain the expression for internal field in solids. **(08 Marks)**

c. Distinguish between hard and soft magnetic materials. **(05 Marks)**

d. Find the polarization produced in a crystal by an electric field of strength 500 Vmm^{-1} if it has a dielectric constant of 6. **(03 Marks)**

5 a. Choose your answers for the following :
   i) Rate of induced absorption depends on
   A) number of atoms in lower energy state   B) the energy density
   C) number of atoms in higher energy state   D) both A and B.
   ii) In semiconductor laser the material used is
   A) any semiconductor   B) direct band gap semiconductor
   C) indirect band gap semiconductor   D) not a semiconductor.
   iii) The required condition to achieve laser action in a system is
   A) state of population inversion   B) existence of metastable state
   C) a resonant cavity   D) all the three
   iv) In recording the image on the photographic plate the reference beam and the object beam undergo _____ at the photographic plate.
   A) diffraction   B) reflection   C) interference   D) polarization
   (04 Marks)

b. Explain the construction and working of He-Ne laser, with the help of suitable diagrams.
   (08 Marks)

c. Mention the applications of holography.   (04 Marks)

d. The average output power of laser source emitting a laser beam of wavelength 633 nm is 5 mW. Find the number of photons emitted per second by the laser source.   (04 Marks)

6 a. Choose your answers for the following :
   i) The critical temperature of mercury is
   A) 4.2 K   B) 6.2 K   C) 7.8 K   D) 20 K
   ii) The temperature of a superconductor kept in a weak magnetic field is reduced below critical temperature, then
   A) $R = 0 ; B \neq 0$ B) $R \neq 0 ; B = 0$ C) $R \neq 0 ; B \neq 0$ D) $R = 0 ; B = 0$
   iii) The numerical aperture of an optical fiber in air is 0.32. The numerical aperture in water ($n_0 = 4/3$) is
   A) 0.43   B) 0.24   C) 0.64   D) 0.96
   iv) Graded index fiber can be
   A) single mode fiber only   B) multimode fiber only
   C) both single mode and multimode   D) depends on the surrounding medium
   (04 Marks)

b. Define the terms : i) angle of acceptance   ii) numerical aperture
   iii) fractional index change   iv) modes of propagation.   (04 Marks)

c. Explain BCS theory of superconductivity. Write a short note on Maglev vehicles.   (08 Marks)

d. The refractive indices of core and cladding are 1.50 and 1.48 respectively in an optical fiber. Find the numerical aperture and angle of acceptance.   (04 Marks)

7 a. Choose your answers for the following :
   i) The relation for angles between axes of a triclinic crystal is
   A) $\alpha = \beta = \gamma = 90^\circ$ B) $\alpha \neq \beta \neq \gamma = 90^\circ$ C) $\alpha \neq \beta \neq \gamma \neq 90^\circ$ D) $\alpha = \beta = \gamma \neq 90^\circ$
   ii) The coordination number for a face centered cubic lattice is
   A) 12   B) 8   C) 6   D) 26
   iii) The packing factor of fcc structure is
   A) 52%   B) 68%   C) 92%   D) none of these
   iv) The Miller indices of the plane parallel to the x and y axes are
   A) (1 0 0)   B) (0 1 0)   C) (0 0 1)   D) (1 1 1)
   (04 Marks)

7 b. Derive an expression for inter planar spacing in terms of Miller indices. (06 Marks)

c. Define packing fraction. Calculate packing fraction for sc and bcc structures. (06 Marks)

d. Inter planar distance for a crystal is 3 Å and the glancing angle for second order spectrum was observed to be equal to 10°30'. Find the wavelength of the X-rays used. (04 Marks)

8 a. Choose your answers for the following :

i) In a carbon nano tube, the bond between the carbon atoms is
   A) metallic   B) ionic   C) hydrogen   D) covalent

ii) Fullerene is
   A) a sheet of carbon atoms rolled up into long tube
   B) sixty carbon atoms arranged in the shape of a football
   C) one dimensional array of atoms
   D) three dimensional array of atoms

iii) Ultrasonic waves are sound waves having
   A) velocity greater than 330 ms^{-1} B) velocity lesser than 330 ms^{-1}
   C) frequency greater than 20000 Hz   D) frequency less than 20000 Hz

iv) The typical size of nano material is between
   A) 1 – 10 nm   B) 10 – 50 nm   C) 1 – 100 nm   D) 1 – 1000 nm
   (04 Marks)

b. What are nano materials? Explain carbon nano tubes and their physical properties. Mention few applications of carbon nano tubes. (08 Marks)

c. Explain the principle and method of nondestructive method of testing of material using ultrasonics. (08 Marks)

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