## First/Second Semester B.E. Degree Examination, June/July 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$^{-1}$.*

*Important Note : i. 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.*

### PART – A

**1** a. Choose your answers for the following :
    i)   In Compton Effect, the wavelength of the x-rays scattered at an angle $\theta > 0$.
        A) increases       B) doesn't change     C) decreases          D) none of these
    ii)  $K_e$, $K_p$ and $K_\alpha$ an respective kinetic energy of an $\bar{e}$, a proton and $\alpha$ - particle of same de-Broglie wavelength, then
        A) $K_e > K_p > K_\alpha$     B) $K_e > K_p < K_\alpha$     C) $K_e < K_p < K_\alpha$     D) $K_e = K_p = K_\alpha$
    iii)  The heavier of the particles has smallest de-Broglie wave length when both of them.
        A) move with same speed             B) move with same momentum
        C) move with same kinetic energy      D) none of these
    iv)  Matter waves are not electromagnetic waves because
        A) they move with variable velocity     B) depend on charge
        C) move with constant velocity         D) none of these     **(04 Marks)**

  b. What are the basic postulates of quantum theory of radiations? Explain how Planck's overcome the drawbacks of Weins law and Rayliegh Jean's law.     **(06 Marks)**
  c. Define group and phase velocity. Derive the expression for de-Broglie wavelength using group velocity concept.     **(06 Marks)**
  d. Compute the de Broglie wavelength for a neutron moving with one tenth part of the velocity of light.     **(04 Marks)**

**2** a. Choose your answers for the following :
    i)   An electron is moving in a box of length a; if $\psi$, is the wave function at $x = \dfrac{a}{4}$ with $n = 1$ and $\psi_2$ at $x = a$ for $n = 2$, then $\dfrac{\psi_2}{\psi_1}$ is

        A) $\dfrac{\sqrt{2}}{a}$          B) $\dfrac{\sqrt{a}}{2}$          C) 0          D) $\infty$
    ii)  For a particle in an infinite potential well in its 1$^{st}$ excited state, the probability of finding the particle at the center of box is
        A) 0          B) 0.25         C) 0.5         D) 0.1
    iii)  To become a nuclear constituent, the K.R of $\bar{e}$ must be of the order of
        A) 20 MeV         B) 2 MeV         C) 20eV         D) zero
    iv)  An electron has a speed of 100 m/s accurate to 0.05%. The uncertainty in its position is
        A) 0.01m         B) 0.0115m       C) 0.024m       D) 0.04m
                                              **(04 Marks)**

b. What is a wave function? Explain the properties of a wave function. (04 Marks)

c. Derive the expression for energy eigen value for an electron in potential well of infinite depth. (06 Marks)

d. A quantum particle confined to one-dimensional box of width 'a' is in its first exerted state. What is the probability of finding the particle over an interval of $\left(\dfrac{a}{2}\right)$ marked symmetrically at the centre of box. (06 Marks)

3 a. Choose your answers for the following :

i) If the mobility of $\bar{e}$ in a metal increases the resistivity

    A) decreases      B) increases      C) remains constant    D) none of these

ii) The temperature dependence of electrical resistivity of metal is

    A) $\rho \alpha \dfrac{1}{T}$      B) $\rho \alpha \dfrac{1}{\sqrt{T}}$      C) $\rho \alpha \sqrt{T}$      D) $\rho \alpha T$

iii) Zero percentage probability is the probability for $\bar{e}$ to occupy the energy level above the Fermi energy level at $T = 0k$ is

    A) $E + E_F$      B) $E = E_F$      C) $E > E_F$      D) $E < E_F$

iv) If the Fermi energy of a metal is 1.4eV, the Fermi temperature of the metal is approximately

    A) $1.6 \times 10^3 \, k$      B) $1.6 \times 10^4 \, k$      C) $1.6 \times 10^5 \, k$      D) $1.6 \times 10^6 \, k$ (04 Marks)

b. Discuss the various drawbacks of classical free electron theory of metals. What are the assumptions made in Quantum theory to overcome the same? (06 Marks)

c. Explain density of states? Derive the expression for electrical conductivity in terms of mean collision time. (06 Marks)

d. The Fermi level potassium is 2.1eV. What are the energies for which the probabilities of occupancy at 300 K are 0.99 and 0.5? (04 Marks)

4 a. Choose your answers for the following :

i) For ferromagnetic substances, the Curie-Weise law is given by

    A) $\psi = \dfrac{C}{T}$      B) $\psi = \dfrac{C}{T - \theta}$      C) $\psi = \dfrac{T - \theta}{C}$      D) $\dfrac{C}{T - \theta}$

ii) Clausius-Mossotti equation does not hold for

    A) gasses      B) liquids      C) crystalline solids    D) none of these

iii) The Ferro electric material losses spontaneous polarization at

    A) room temperature    B) 0 K      C) $T_C K$      D) 100 K

iv) In hysterisis, polarization

    A) moves with the electric field      B) lags behind electric filed

    C) ahead to the electric field      D) none of these. (04 Marks)

b. Explain the term internal field. Derive an expression for internal field in the case of one dimensional array of atoms in di-electric solids. (07 Marks)

c. Derive Clausius-Mossotti equation. (04 Marks)

d. Sulphur is elemental solid di-electric whose di-electric constant is 3.4. Calculate the electronic polarizability if its density is $2.07 \times 10^3 \, kg/m^3$ and atomic weight is 32.07. (05 Marks)

## PART – B

5  a.  Choose your answers for the following :
   i)  Wavelength of a laser beam can be used as a standard of
       A) time            B) temperature      C) angle           D) length
   ii)  Image is stored on a hologram in the form of
       A) interference pattern                 B) diffraction pattern
       C) photograph                           D) none of these
   iii)  Which event is likely to takes place, when a photon of energy equal to the difference
         in energy between two levels is incident in a system
       A) absorption                           B) emission
       C)  absorption and emission             D) none of these
   iv)  Quartz plates are fixed at the ends of the discharge tube in a He-Ne laser so that
       A) there won't be leakage of gas
       B) the tube can withstand high electric voltage
       C) the loses light can pass out without any loss
       D) the emergency light is polarized                                    (04 Marks)
   b.  Explain the requisites and conditions of a laser system.                (05 Marks)
   c.  Describe the principle and working of LIDAR used to measure pollutant in atmosphere.
                                                                                (06 Marks)
   d.  Find the member of mode of standing waves and their frequency separation in the resonant
       cavity of 1m length of He-Ne operating at a wavelength of 632.8nm.       (05 Marks)

6  a.  Choose your answers for the following :
   i)  The conductivity of a superconductor is
       A) infinite        B) zero             C) finite          D) none of these
   ii)  The relation between superconducting transition temperature ($T_C$) and atomic
        weight ($\mu$) of isotope is

       A) $T_C \alpha \mu$     B) $T_C \alpha \dfrac{1}{\mu}$     C) $T_C \alpha \sqrt{\mu}$     D) $T_C \alpha \dfrac{1}{\sqrt{\mu}}$

   iii)  If optic fibre is kept in a medium of R.I. $\mu$ (>1) instead of air, the acceptance angle
       A) increases       B) decreases        C)  remains constant   D) none of these
   iv)  In graded index fibre, the R.I, of cladding varies
       A) exponentially   B) linearly         C) parabolically   D) none of these
                                                                                (04 Marks)
   b.  Discuss types of optical fibres and modes of propagation using suitable diagram.  (06 Marks)
   c.  Distinguish between type- I and type – II superconductors.              (05 Marks)
   d.  The angle of acceptance of an optical fibre is $30^0$ when kept in air. Find the angle of
       acceptance when it is in a medium of R.I. 1.33.                         (05 Marks)

7  a.  Choose your answers for the following :
   i)  Four types of Bravais lattices are obtained in
       A) rhombhohedral system                 B) orthorhombic system
       C)  triclinic system                    D) monoclinic system
   ii)  In BCC structure, the packing density of crystal is equal to

       A) $\dfrac{\sqrt{3}\pi}{8}$     B) $\dfrac{\sqrt{3}\pi}{8}$     C) $\dfrac{3\pi}{8}$     D) $\dfrac{3\sqrt{3}\pi}{8}$

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