USN ☐☐☐☐☐☐☐☐☐☐

First/Second Semester B.E. Degree Examination, December 2010
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 : Mass of the electron = m = 9.11 × 10⁻³¹ kg, Charge of the electron = e = 1.6 × 10⁻¹⁹ C, Velocity of light = c = 3 × 10⁸ m/s, Planck's constant = h = 6.626 × 10⁻³⁴ J-S, Boltzmann constant = k = 1.38 × 10⁻²³ J/K, Permittivity of free space = ε₀ = 8.854 × 10⁻¹² F/m, Avogadro number = NA = 6.022 × 10²⁶/K mole.*

PART – A

1 a. Choose your answers for the following :
   i)   In the black body radiation spectrum, with increasing temperature, the wavelength corresponding to maximum intensity shifts towards :
        A) Longer wavelength side   B) Shorter wavelength side
        C) Initially longer, later shorter wavelength side   D) None of these
   ii) The Davisson Germer experiment establishes
        A) Particle nature of X rays   B) Dual nature of light
        C) Dual nature of particles   D) Wave nature of particles
   iii) For a wave packet
        A) $V_{gp} = V_{particle}$ B) $V_{gp} = V_{phase}$ C) $V_{gp} = G$ D) None of these
   iv) For a photon and electron of equal wavelengths, their
        A) Energies are equal   B) Momenta are equal
        C) Both A and B   D) Neither A nor B   **(04 Marks)**

   b. Define phase velocity and group velocity. Derive an expression for the de Broglie wavelength from the concept of group velocity.   **(10 Marks)**

   c. An electron has a de Broglie wavelength 3 nm, and rest mass 0.511 eV. Determine its group velocity and kinetic energy.   **(06 Marks)**

2 a. Choose your answers for the following :
   i)   The eigen functions associated with a system are
        A) Single valued and continuous   B) Finite and continuous
        C) Finite, single valued and continuous   D) Infinite, continuous and single valued
   ii) In the expression $p = \sqrt{2mE}$ where p is the momentum, E represents
        A) Kinetic energy   B) Total energy   C) Potential energy   D) Rest energy
   iii) For a particle moving in a potential well, the probability of finding it anywhere over the width of the well is
        A) 1.0   B) 0.0   C) 0.5   D) 1.5
   iv) For a free particle, the energy eigen values are
        A) Quantized   B) Continuous   C) Zero   D) None of these   **(04 Marks)**

   b. Determine the energy eigen values and eigen functions for a particle in a one dimensional potential well of infinite height.   **(10 Marks)**

   c. State Heisenberg's uncertainty principle. A spectral line of wavelength 546.1 nm has a width 10⁻⁵ nm. Estimate the minimum time spent by electrons in the excited state during transitions.   **(06 Marks)**

3 a Choose your answers for the following :
    i) The unit (units) of electric field intensity, E, is (are)
        A) Volt/m   B) N/Coulomb   C) J/Coulomb   D) Both A and
    ii) In a conductor, the resistivity, ρ, increases as
        A) Temperature decreases   B) Temperature increases
        C) Does not depend on temperature   D) None of these
    iii) The Fermi factor at E_{F_o} for T > 0 k is
        A) 0   B) 0.5   C) 1.0   D) 0.25
    iv) The mobility μ of conduction electrons in a metal is given by
        A) $\frac{E}{V_d}$ B) $\frac{V_d}{E}$ C) $\frac{\sigma}{ne}$ D) Both B and C   **(04 Marks)**

  b. Derive an expression for the electrical conductivity, σ, in a metal.   **(06 Marks)**
  c. Discuss any two successes (or merits) of the quantum free electron theory of conduction.   **(06 Marks)**
  d. The Fermi level for a metal is 3.1 eV, Calculate the energies for which the probability of occupancy at 300 K are 98% and 50%.   **(04 Marks)**

4 a. Choose your answers for the following :
    i) The dipole moment of two charges +q and –q separated by a distance d is given by
        A) +qd   B) -qd   C) q^2/d D) q^2d
    ii) Temperature independent polarization mechanisms are
        A) Electronic and orientational
        B) Ionic and orientational
        C) Electronic and space charge
        D) Electronic and ionic
    iii) Ferroelectric materials are
        A) Magnetic
        B) Dielectrics
        C) Magnetic materials which behave like dielectrics
        D) Dielectric materials that behave like magnetic
    iv) In the B-H curve, the points X and Y represent respectively
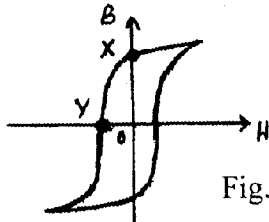
Fig.Q4(a)(iv)

     A) Coercive field and remnant magnetization
     B) Remnant magnetization and coercive field
     C) Saturation density and coercive field
     D) Remnant magnetization and susceptibility
     (04 Marks)

  b. Arrive at an expression for the internal field in a linear array of dielectric molecules placed in an electric field.   **(08 Marks)**
  c. What is Lorentz field? Deduce Clausius Mossotti relation.   **(04 Marks)**
  d. A solid dielectric material has electronic polarisability equal to 7×10^{-40} Fm^2. If it is a cubic structure, calculate the relative permittivity of the material if it has 3×10^{28} atoms/m^3.   **(04 Marks)**

PART – B

5 a. Choose your answers for the following :
   i) The life time of an electron in a metastable state is of the order of
      A) Nano seconds   B) Micro seconds   C) Few seconds   D) Milli seconds
   ii) The excitation mechanism for pumping in a diode laser is
      A) Forward bias   B) Optical   C) Electrical discharge   D) None of these
   iii) The energy of laser pulse is 10^{-10} J. If the power of the laser is 8 mW, the duration of the pulse is
      A) 125 ns   B) 0.125 ns   C) 12.5 ns   D) 1.25 ns
   iv) In the He-Ne laser the ratio of the partial pressures of He and Ne gases is
      A) 1 : 10   B) 10 : 1   C) 1 : 100   D) 100 : 1   (04 Marks)

   b. Discuss the principle, construction and working of a semiconductor laser. State two advantages and two applications of the same.   (12 Marks)

   c. The ratio of population of two energy states in a laser is 1.059×10^{-30}. If the temperature of the system is 57°C, what is the wavelength of the laser?   (04 Marks)

6 a. Choose your answers for the following :
   i) Type – I superconductors are
      A) Diamagnetic   B) Paramagnetic   C) Ferromagnetic   D) Antiferromagnetic
   ii) For a superconductor, stronger the magnetic field applied to it
      A) Higher is the critical temperature   B) Lower is the critical temperature
      C) Critical temperature remains same   D) None of these
   iii) The number of modes supported by an optical fiber whose V. no. is 40 is
      A) 1600   B) 1200   C) 800   D) 3200
   iv) The numerical aperture of an optical fiber is 0.309. Its angle of acceptance is approximately
      A) 18°   B) 17°   C) 18.5°   D) 17.5°   (04 Marks)

   b. Derive the condition for ray propagation through an optical fiber.   (06 Marks)
   c. Discuss the construction, working and applications of squids.   (06 Marks)
   d. A signal with input power 200 mW loses 10% of its power after traveling a distance of 3000 m. Find the attenuation coefficient of the fiber.   (04 Marks)

7 a. Choose your answers for the following :
   i) The inter atomic distance for the NaCl lattice is

      A) 5.63 Å   B) 2.81 Å   C) 11.26 Å   D) 1.41 Å
   ii) The number of lattice points/unit cell in diamond is
      A) 4   B) 6   C) 2   D) 8
   iii) According to Bragg's law which of the following triplets corresponds to the first three orders of reflection?
      A) 10°, 23.9°, 40.4°   B) 12°, 24.57°, 38.6°   C) 15°, 38.4°, 42°   D) 14°, 28°, 42°
   iv) In the Bragg's spectrometer, if the detector rotates by 6°, the crystal table would have rotated by
      A) 3°   B) 12°   C) 2°   D) 9°   (04 Marks)

b. Arrive at an expression for the inter planar spacing for a family of Bravais planes with miller indices (h, k, l) **(06 Marks)**

c. Determine the coordination number, number of lattice points per unit cell and atomic packing factor for the FCC lattice. (or face centred cubic lattice) **(06 Marks)**

d. Draw the following planes in the unit cube: i) $(\bar{1}, 0, 2)$ ii) $(1, \bar{1}, \bar{2})$ **(04 Marks)**

8 a. Choose your answers for the following :
   i) Reduction of 3-d bulk material in all the three directions results in
      A) 2-d firen   B) 1 d wire   C) Quantum dot   D) Quantum particle
   ii) In mechanical scaling, the dimensional dependence of frequency is
      A) L^{-1} B) L   C) L^2 D) L^{-2}
   iii) Which of these is not employed in non destructive testing?
      A) Ultrasound method   B) Dynamic testing
      C) Testing by chemical interaction   D) Magnetic methods
   iv) Ultrasonic waves in solids are
      A) Longitudinal   B) Transverse
      C) Could be both A and B   D) None of these   **(04 Marks)**

b. Write short notes on: i) Carbon nano tube ii) Self organization on the nano scale **(08 Marks)**

c. Discuss the principle and working of the ultrasonic method of nondestructive testing. **(08 Marks)**

* * * * *