



**First/Second Semester B.E. Degree Examination, January 2013**  
**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 : Velocity of light,  $c = 3 \times 10^8$  m/s, Planck's constant,  $h = 6.625 \times 10^{-34}$  JS, Electron charge,  $e = 1.602 \times 10^{-19}$  C, Mass of Electron,  $m = 9.11 \times 10^{-31}$  kg, Avogadro number,  $N_A = 6.02 \times 10^{26}$ /Kmole, Permittivity of vacuum  $\epsilon_0 = 8.85 \times 10^{-12}$  F/m, Boltzmann constant,  $K = 1.38 \times 10^{-23}$  J/K.**

**PART - A**

- 1 a.** Choose the correct answers for the following : (04 Marks)
- The law which failed to account for shorter wavelength region of black body radiation spectrum is,  
 A) Wein's law      B) Rayleigh-Jean's law      C) Planck's law      D) Maxwell's law
  - The de-Broglie wavelength of a particle at rest is  
 A) Zero      B) infinite      C)  $h/p$       D)  $h/v$
  - If group velocity of particle is  $4.7 \times 10^6$  m/s then its phase velocity is,  
 A)  $6 \times 10^0$  m/s      B)  $4.7 \times 10^6$  m/s      C)  $9.4 \times 10^6$  m/s      D)  $1.91 \times 10^{10}$  m/s
  - The particle velocity of wave is equal to,  
 A) group velocity      B) phase velocity      C) velocity of light      D) velocity of sound
- b.** Describe Davisson and Germer experiment for confirmation of de-Broglie hypothesis. (07 Marks)
- c.** Derive de-Broglie wavelength using group velocity. (05 Marks)
- d.** Calculate the de-Broglie wavelength of particle of mass 0.65 MeV/C<sup>2</sup> has a kinetic energy 80 eV. (04 Marks)
- 2 a.** Choose the correct answers for the following : (04 Marks)
- In quantum mechanics the energy operation is represented as:  
 A)  $\frac{8\pi^2 m}{h^2} \frac{\partial^2}{\partial x^2}$       B)  $-\frac{h^2}{4\pi^2 m} \frac{\partial^2}{\partial x^2}$       C)  $-\frac{h^2}{8\pi^2 m} \frac{\partial^2}{\partial x^2}$       D)  $\frac{h^2}{2\pi^2 m} \frac{\partial^2}{\partial x^2}$
  - The probability of finding the particle within an element of volume  $d\tau$  is,  
 A) zero      B)  $\int |\psi|^2 d\tau$       C)  $\int |\psi| d\tau$       D)  $\int |\psi^*| d\tau$
  - If an electron moves in one dimensional box of length 2 nm, the normalization constant is,  
 A)  $1(\text{nm})^{-1/2}$       B)  $2(\text{nm})^{-1}$       C)  $\sqrt{2}(\text{nm})^{-1}$       D) zero
  - The energy of a particle  $E_n$  in one-dimensional potential box of width L and infinite height is,  
 A)  $nh / 8mL^2$       B)  $nh / 8 mL$       C)  $n^2 h^2 / mL^2$       D)  $n^2 h^2 / 8 mL^2$
- b.** Set up Schrodinger's time-independent wave equation. (08 Marks)
- c.** Using uncertainty principle, prove that free electron does not exist inside the nucleus. (04 Marks)
- d.** A spectral line of wavelength 4000 A°U has width of  $8 \times 10^{-5}$  AU. Evaluate the minimum time spent by electrons in upper energy state between excitation and de-excitation processes. (04 Marks)
- 3 a.** Choose the correct answers for the following : (04 Marks)
- The free electrons in classical free electron theory are treated as:  
 A) rigidly fixed lattice points      B) liquid molecules      C) gas molecules      D) none of these
  - The temperature dependence of classical expression for electrical resistivity of a metal is,  
 A)  $\rho \propto T^{1/2}$       B)  $\rho \propto T^2$       C)  $\rho \propto 1/T^2$       D)  $\rho \propto 1/T$
  - The value of Fermi function in Fermi-level is at  $T \neq 0$  K,  
 A) zero      B) 0.5      C) 0.75      D) 1
  - If  $E_F$  is the Fermi energy at absolute zero, then mean energy  $\bar{E}$  of electron at absolute zero is,  
 A)  $\bar{E} = 1.5E_F$       B)  $\bar{E} = 2/3 E_F$       C)  $\bar{E} = 2/5 E_F$       D)  $\bar{E} = 3/5 E_F$
- b.** Explain failure of classical free electron theory. (06 Marks)
- c.** What are the merits of quantum free electron theory? (06 Marks)
- d.** Calculate the Fermi velocity and mean free path for conduction electrons in silver, given that its Fermi energy is 5.5 eV and relaxation time for electrons is  $3.83 \times 10^{-14}$  s. (04 Marks)
- 4 a.** Choose the correct answers for the following : (04 Marks)
- The electric dipole moment per unit volume is,  
 A) magnetization      B) dipole moment      C) electric polarization      D) electric susceptibility
  - Claussius - Musotti equation does not holds for,  
 A) crystalline solids      B) liquids      C) gases      D) vacuum

## Contd... Q4 (a)

- iii) The relation between B, M and H is,  
 A)  $H = \mu_0(M + B)$       B)  $B = \mu_0(H + M)$       C)  $M = \mu_0(H + B)$       D) None of these
- iv) Above curie temperature ferromagnetic substance becomes:  
 A) anti-ferromagnetic      B) strongly ferromagnetic      C) paramagnetic      D) diamagnetic
- b. Discuss polarization mechanism in dielectrics and their frequency dependence. (08 Marks)
- c. Differentiate hard and soft magnetic materials with suitable application. (04 Marks)
- d. An electric field of  $10^5$  V/m is applied on a sample of neon at NTP. Calculate the dipole moment induced in each atom. The dielectric constant of neon is 1.00014. Find the atomic polarizability of neon gas. At NTP 1 kg atom of Ne – gas occupies volume of  $22.4 \text{ m}^3$ . (04 Marks)

**PART – B**

- 5 a. Choose the correct answers for the following : (04 Marks)
- i) In He-Ne laser the laser emission takes place from,  
 A) He-atoms only      B) Ne-atoms only  
 C) both He and Ne atoms      D) 50% from Helium and 50% from Neon
- ii) Which of the following leads coherent light:  
 A) induced absorption      B) Spontaneous emission      C) Stimulated emission      D) None of these
- iii) The pumping method used in semiconductor diode laser is,  
 A) optical pumping      B) electric discharge      C) forward bias      D) chemical reactions
- iv) The life time of metastable state is about,  
 A)  $10^{-3}$  sec      B)  $10^{-13}$  sec      C)  $10^2$  sec      D)  $10^{-9}$  sec
- b. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein coefficient. (08 Marks)
- c. What is holography? Explain principle of hologram recording using laser. (04 Marks)
- d. A pulsed laser with power 1 mw lasts for ions. If the number of photons emitted per second is  $5 \times 10^7$ . Calculate the wavelength of laser. (04 Marks)
- 6 a. Choose the correct answers for the following : (04 Marks)
- i) According to BCS theory, the cooper pair is pair of,  
 A) Electron-Proton      B) Electron-Electron      C) Proton-Proton      D) Electron-Neutron
- ii) High temperature superconductors bear the crystal structure of,  
 A) cubic      B) orthorhombic      C) diamond      D) perovskite
- iii) The acceptance angle of optical fiber whose RI of core and cladding of 1.55 and 1.50 respectively is,  
 A)  $32^\circ$       B)  $45^\circ$       C)  $23^\circ$       D)  $15^\circ$
- iv) According to Meissner effect, material in super conducting state is,  
 A) paramagnetic      B) diamagnetic      C) ferromagnetic      D) anti-ferromagnetic
- b. What is refractive index profile? Describe three types of optical fiber with one application for each type. (08 Marks)
- c. Explain working of SQUID with application. (04 Marks)
- d. An optical fiber of 600 mts long has input power of 120 mw which emerges out with power of 90 mw. Find attenuation in the fiber. (04 Marks)
- 7 a. Choose the correct answers for the following : (04 Marks)
- i) The lattice parameters  $a = b \neq c$  and  $\alpha = \beta = \gamma = 90^\circ$  represent,  
 A) cubic      B) tetragonal      C) rhombohedral      D) orthorhombic
- ii) The co-ordination number of rock salt is,  
 A) 6      B) 8      C) 12      D) 14
- iii) Which of the following has least packing fraction,  
 A) sc      B) bcc      C) fcc      D) diamond
- iv) In a simple cubic lattice  $d_{111} : d_{110} : d_{100} =$   
 A)  $\sqrt{6} : \sqrt{3} : \sqrt{2}$       B)  $\sqrt{2} : \sqrt{6} : \sqrt{3}$       C)  $\sqrt{2} : \sqrt{3} : \sqrt{6}$       D)  $\sqrt{3} : \sqrt{6} : \sqrt{2}$
- b. Derive expression for interplanar spacing of crystal in terms of Miller Indices. (07 Marks)
- c. What is atomic packing factor? Calculate packing factor for sc and bcc structure. (05 Marks)
- d. What is Miller Index of plane making intercepts ratio  $3a : 4b$  on x- and y- axis and parallel to z-axis. a, b are primitive vectors? (04 Marks)
- 8 a. Choose the correct answers for the following : (04 Marks)
- i) A bulk material (three dimensions) reduced in one direction is called quantum:  
 A) particle      B) well      C) dot      D) wire
- ii) Which belongs to fullerene family?  
 A)  $C_{60}$       B)  $C_{70}$       C)  $C_{120}$       D) All
- iii) Velocity of ultrasound through liquid is proportional to,  
 A) density      B) volume      C) bulk modulus      D) rigidity modulus
- iv) Ultrasonic waves cannot be transmitted through,  
 A) solid      B) liquid      C) gas      D) vacuum
- b. What is NDT? Describe the NDT method of detection of flows in solid using ultrasound. (08 Marks)
- c. What are nano materials? Write the structure and applications of carbon nano tubes. (08 Marks)