



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, Plank'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,

$N_A = 6.02 \times 10^{26}$ /K mole, 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 4.7×10^6 m/s then its phase velocity is,
A) 6×10^9 m/s B) 4.7×10^6 m/s C) 9.4×10^6 m/s D) 1.91×10^{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/C² 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 dt is,
A) zero B) $\int |\psi|^2 dt$ C) $\int |\psi| dt$ D) $\int |\psi^*| dt$
 - 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) $nh / 8mL$ C) n^2h^2 / mL^2 D) $n^2h^2 / 8mL^2$
- 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 8×10^{-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 3.83×10^{-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 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 5×10^7 . 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° B) 45° C) 23° D) 15°
- 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)