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First/Second Semester B.E. Degree Examination, December 2012**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 : Planck's constant, $h = 6.63 \times 10^{-34}$ J-S,**

Velocity of light, $c = 3 \times 10^8$ m/s,

Permittivity of vacuum, $\epsilon_0 = 8.85 \times 10^{-12}$ F/m

Electron mass, $m = 9.11 \times 10^{-31}$ kg,

Electron charge, $e = 1.6 \times 10^{-19}$ C

Avogadro's number, $N_A = 6.025 \times 10^{26}$ /Kmole

Boltzmann constant, $k = 1.38 \times 10^{-23}$ J/K,

PART – A

- 1** a. Choose the correct answers for the following :
- i) Wien's distribution law explains black body radiation spectrum only for

A) entire spectrum	B) Longer wave length
C) shorter wave length	D) none of these
 - ii) de Broglie wave length of an electron accelerated by a potential of 100 V is

A) 0.01226 nm	B) 0.1226 nm	C) 1.226 nm	D) 12.26 nm
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 - iii) Phase velocity of the matter wave is

A) $= V_{\text{particle}}$	B) $< V_{\text{particle}}$	C) $> V_{\text{particle}}$	D) $= 3 V_{\text{particle}}$
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 - iv) The momentum of a free particle carrying energy E and mass m is

A) 2 mE	B) $\sqrt{2mE}$	C) $2\sqrt{mE}$	D) m^2E^2 (04 Marks)
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- b. Explain Planck's distribution law. (04 Marks)
- c. Explain phase velocity and group velocity. Derive the relation between them. (08 Marks)
- d. A neutron has wave length of 0.166 nm. Find the free energy and velocity of the de Broglie wave. Mass of neutron is $m_n = 1.678 \times 10^{-27}$ kg. (04 Marks)
- 2** a. Choose the correct answers for the following :
- i) The first permitted eigen energy is called

A) first level energy	B) zero point energy
C) maximum energy	D) none of these
 - ii) The amplitude of the eigen function of particle trapped in infinite potential well of width 'a' is given by

A) $\frac{\sqrt{2}}{\sqrt{a}}$	B) $\frac{\sqrt{2}}{\sqrt{7}}$	C) $\frac{\sqrt{a}}{\sqrt{2}}$	D) $\frac{2}{a}$
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 - iii) The product of uncertainty between position and momentum is

A) $\geq \frac{h}{6\pi}$	B) $\leq \frac{h}{2\pi}$	C) $\geq \frac{h}{4\pi}$	D) $\leq \frac{h}{6\pi}$
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 - iv) The diameter of the nucleus is of the order

A) 10^{-4} m	B) 10^{-15} m	C) 10^{-25} m	D) 10^{-45} m (04 Marks)
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- 2 b. Show that the electrons cannot exist in the nucleus of an atom. (05 Marks)
 c. Set up the time independent Schrodinger's wave equation. (06 Marks)
 d. An electron is bound in one dimensional box of width 0.16 nm. Find the energy values in the ground state and first two excited states. (05 Marks)
- 3 a. Choose the correct answers for the following :
- Specific heat of 1 mole of electron gas under constant volume is
 A) $\frac{3}{5}R$ B) $\frac{R}{2}$ C) $3R$ D) $\frac{3}{2}R$
 - Fermi energy of a metal at 0°K depends on
 A) kinetic energy of electron B) potential energy of electron
 C) constant D) number of free electrons/unit volume
 - Resistivity of a metal with temperature varies as
 A) T^3 B) T^2 C) T^5 D) T
 - Ideal resistivity does not depend upon
 A) temperature B) inter atomic spacing
 C) impurity D) lattice defect (04 Marks)
- b. Elucidate the difference between classical free electron theory and quantum free electron theory. (06 Marks)
 c. Define density of states. Derive the expression for density of states. (10 Marks)
- 4 a. Choose the correct answers for the following :
- The unit of dipole moment/unit volume is
 A) coulomb/metre B) coulomb/metre²
 C) coulomb/metre³ D) coulomb
 - Monoatomic gas atom is placed in a uniform electric field \vec{E} , then the resulting induced dipolemoment is proportional to
 A) E B) E^2 C) E^3 D) independent of E
 - In a dielectric, the orientation polarization is exhibited by
 A) polar dielectric B) non polar dielectric
 C) mixture of both D) none of these
 - Piezo electric effect is the production of electricity by
 A) chemical effect B) varying field C) temperature D) pressure (04 Marks)
- b. Explain the properties of ferromagnetic materials. (04 Marks)
 c. Derive the expression for internal field in liquids and solids for one dimensional atomic array. (08 Marks)
 d. What is the polarization produced in NaCl/ by an electric field of 500 V/mm if it has dielectric constant of 5.7? (04 Marks)

PART – B

- 5 a. Choose the correct answers for the following :
- The transition of an atom between two energy levels in which two coherent photons are emitted is called
 A) induced absorption B) spontaneous emission
 C) stimulated emission D) population inversion

- 5 a. ii) The distribution of number of atoms in different discrete energy states is governed by
A) Fermi-Dirac distribution B) Maxwell-Boltzmann distribution
C) Bose-Einstein distribution D) None of these
- iii) Brewster's window's are used in He-Ne laser to obtain
A) coherent light B) monochromatic light
C) powerful light D) polarized light
- iv) The wave length of light from a semiconductor laser is proportional to
A) E_g B) $(E_g)^2$ C) $\frac{1}{E_g}$ D) $\frac{1}{(E_g)^2}$
- (04 Marks)
- b. Deduce the expression for energy density using Einstein's coefficients and show that probability of induced absorption is equal to probability of stimulated emission. (08 Marks)
- c. With a neat diagram, explain the construction and working of He-Ne laser. (08 Marks)
- 6 a. Choose the correct answers for the following :
- i) Below transition temperature superconductors behave like perfect.
A) diamagnets B) paramagnets C) ferromagnets D) ferrimagnets
- ii) SQUIDS are devices that can detect very small changes in
A) electric fields B) magnetic fields
C) gravitational fields D) radio activity
- iii) Number of modes transmitted by an optical fibre is proportional to
A) λ B) λ^2 C) $1/\lambda$ D) $1/\lambda^2$
- iv) One of the reasons of attenuation in optical fibers is
A) refraction B) reflection C) absorption D) interference
- (04 Marks)
- b. Explain briefly the BCS theory of superconductivity. (06 Marks)
- c. Describe the different types of optical fibres with ray propagation and refractive index profile diagrams. (06 Marks)
- d. An optical fiber has attenuation of 1.5 dB/km. What is the output power if the input power is 10 mW and the fibre is 3000 m long? (04 Marks)
- 7 a. Choose the correct answers for the following :
- i) A plane has intercepts at a , $\frac{b}{2}$, $3c$ in a unit cell. The miller indices of the plane are
A) (1 3 2) B) (2 6 1) C) (3 6 1) D) (1 2 3)
- ii) The number of lattice points in a primitive cell are
A) 1 B) 1/2 C) 2 D) 3/2
- iii) The coordination number in the case of simple cubic crystal structure is
A) 12 B) 6 C) 2 D) 1
- iv) The number of molecules present in the unit cell of sodium chloride is
A) 5 B) 2 C) 4 D) None of these
- (04 Marks)
- b. Define: i) packing factor and ii) coordination number. Calculate the packing factor and coordination number for SC, BCC and FCC structures. (12 Marks)
- c. Find the miller indices of a set of parallel planes which make intercepts in the ratio 3a:4b on x and y axes and, are parallel to z axis, a, b, c being primitive vectors of the lattice. (04 Marks)

- 8 a. Choose the correct answers for the following :
- i) Under scaling, self inductance of coil is proportional to
 - A) L^2
 - B) L
 - C) L^3
 - D) Independent of scaling
 - ii) Under scaling current density is proportional to
 - A) L^2
 - B) L
 - C) L^{-1}
 - D) Independent of scaling
 - iii) According to electromagnetic scaling laws current is proportional to
 - A) L^2
 - B) L^3
 - C) L
 - D) L^{-1}
 - iv) Nano-materials are thermodynamically in
 - A) stable state
 - B) unstable state
 - C) meta stable state
 - D) none of these
- b. Write a note on carbon nano tube and mention their application. (04 Marks)
- c. What is acoustic grating? With a neat diagram, explain the determination of velocity of ultrasonic waves using acoustic grating. (08 Marks)
- d. Give the electromagnetic scaling laws for both steady state and time dependent system. (04 Marks)

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