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10PHY12/22

First/Second Semester B.E. Degree Examination, June 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 on OMR sheet page 5 of the answer booklet.***
3. ***Answer to objective type questions on sheets other than OMR will not be valued.***
4. ***Constants to be given, mass of electron = 9.11×10^{-31}kg, e = 1.6×10^{-19}C, c = 3×10^{8}m/s, h = 6.626×10^{-34}JS, k = 1.38×10^{-23} J/k, $t_o = 8.854 \times 10^{-12}$ F/m, $N_A = 6.022 \times 10^{26}$/K mole.***

PART – A

1 a. Choose your answers for the following : **(04 Marks)**

i) Ultraviolet catastrophe is the failure of Rayleigh-Jeans law in explaining the black-body radiation for wavelength.
A) equal to that in visible range B) longer than that of violet light
C) shorter than that of violet light D) None of these

ii) Photo-electric effect establishes
A) wave nature of light B) particle nature of light
C) dual nature of light D) None of these

iii) If the group velocity of the de-Broglie waves associated with a particle is 3×10^4 m/s, the velocity of the particle is
A) 3×10^8 m/s B) 3×10^{12} m/s C) 3×10^4 m/s D) None of these

iv) The Compton wavelength is given by
A) h/m_oc^2 B) h^2/m_oc^2 C) h/m_oc D) $h^2/2m_oc$

b. State de-Broglie hypothesis. Using the de-Broglie wavelength expression, show that an electron accelerated by a potential difference V volt is $\lambda = 1.226 \times 10^{-9}/\sqrt{v}$. **(05 Marks)**

c. Define group velocity and obtain expression for the same. **(06 Marks)**

d. Find the de-Broglie wavelength of an electron accelerated through a potential difference of 182 volts and object of mass 1 kg moving with a speed of (1 m/s) compare the results and comment. **(05 Marks)**

2 a. Choose your answers for the following : **(04 Marks)**

i) If the uncertainity in momentum is large, the uncertainity in wavelength is
A) Small B) Large C) Zero D) None of these

ii) If the wave packet is narrow then there is
A) Large uncertainity in momentum B) Small uncertainity in momentum
C) No uncertainity in momentum D) None of these

iii) An electron, a proton and an α-particle are enclosed in three one dimensional boxes of the same width. The energy levels will be closer together for
A) Electron B) Proton C) Alpha particle D) None of these

iv) If the electron moves in one-dimensional box of length 2nm, the normalization constant is
A) $1(nm)^{-1/2}$ B) $2(nm)^{-1}$ C) $\left[\sqrt{2}nm\right]^{-1}$ D) None of these

b. State Heisenberg's uncertainity principle. Using uncertainity principle explain the non-existence of electron in the nucleus. **(07 Marks)**

c. Set up time independent Schrodinger wave equation for free particle in one-dimension using complex variables. Write the expression for zero point energy. **(05 Marks)**

d. A particle moving in one-dimension box is described by the wave function

$\psi = x\left[\sqrt{3}\right]$ for $0 < x < 1$

$\psi = 0$ elsewhere

and

Find the probability of finding the particle within the interval $\left(0, \frac{1}{2}\right)$. **(04 Marks)**

3 a. Choose your answers for the following : **(04 Marks)**

i) In classical free electron theory, the electric field due to ion cores.

A) is neglected B) is assumed to be periodic

C) is assumed to be constant D) None of these

ii) Mobility of electron is

A) reciprocal of electrical conductivity

B) acceleration of electron per unit ele. field

C) average drift velocity per unit electric field

D) None of these

iii) If E_F is the Fermi energy at absolute zero, then mean energy of the electron at absolute zero is

A) $\bar{E} = 1.5\, E_F$ B) $\bar{E} = \frac{2}{3} E_F$ C) $\bar{E} = \frac{2}{5} E_F$ D) $\bar{E} = \frac{3}{5} E_F$

iv) The resistivity of metals is due to scattering of electron by

A) phonons B) lattice imperfection

C) impurities D) All of these

b. Explain the terms

i) Relaxation time; ii) Mean collision time; iii) Drift velocity **(06 Marks)**

c. Define Fermi energy. Discuss the Fermi factor $f(\sigma)$ for cases $E < E_F$, $E > E_F$ at $T = 0$, $E = E_F$ at $T \neq 0$. **(05 Marks)**

d. Calculate the conductivity of sodium given $\tau_m = 2 \times 10^{-14}$S. Density of sodium is 971 kg/mt^3. its atomic weight is 23 and has one conduction electron/atom. **(05 Marks)**

4 a. Choose your answers for the following : **(04 Marks)**

i) The electric dipole moment per unit volume is

A) Magnetization B) Dipole moment

C) Electric polarization D) Electric susceptibility.

ii) The comparatively, high value of t_r for water suggests that it is

A) Semi conductor B) Conductor

C) Di-electric D) Superconductor

iii) All materials have

A) Diamagnetic property B) Ferrimagnetic property

C) Ferromegnetic property D) Paramagnetic property

iv) In ionic solid dielectric as the temperature increases the ionic polarization

A) Increases B) decreases

C) remain constant D) None of these

b. Derive Clausius-Mossotti equation. **(05 Marks)**

c. Describe any three polarization mechanisms with example. **(06 Marks)**

d. An elemental solid containing 2×10^{28} atoms/mt^3 shows an electronic polarizability of 2×10^{-40} Fmt^2. Assuming a Lorentz force field to be operative, calculate the di-electric constant of the material. **(05 Marks)**

PART – B

5 a. Choose your answers for the following : **(04 Marks)**

i) Spontaneous emission of light produces
   A) coherent light B) incoherent light
   C) unidirectional light D) None of these

ii) The He-Ne laser is a
   A) high power continuous laser B) high power pulsed laser
   C) low power continuous laser D) low power pulsed laser

iii) The life time of an atom in a metastable state is of the order of
   A) a few seconds B) unlimited time
   C) a nanosecond D) few milliseconds.

iv) From a broken hologram which is 10% of the original, if reconstruction of image is being done, then
   A) only 10% of information of the object can be obtained.
   B) complete information of the object is obtained.
   C) no information of the object can be obtained.
   D) None of these

b. Explain the terms
   i) Resonant cavity; ii) Metastable state; iii) Stimulated emission. **(06 Marks)**

c. Describe the construction and working of He-Ne laser with the help of energy level diagram. **(06 Marks)**

d. The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 330K. **(04 Marks)**

6 a. Choose your answers for the following : **(04 Marks)**

i) In a superconductor in superconducting state critical magnetic field
   A) increases if temperature decreases B) increase with increase in temperature
   C) does not depend on temperature D) remain content

ii) If the optical fibre is kept in a medium of $\mu > 1$ instead of air, the acceptance angle
   A) increases B) decreases
   C) remains same D) None of these

iii) Attenuation in optic fibre is due to
   A) absorption B) scattering
   C) radiation loss D) all the above

iv) Numerical aperture of an optical fibre depends on
   A) acceptance angle B) η of cladding
   C) η_{core} of material D) All of these

b. Discuss the different types of optical fibres with suitable diagrams. **(06 Marks)**

c. Write a short note on Masslex vehicles. **(05 Marks)**

d. Calculate the N.A., V-number and number of modes in an optical fibre of core diameter 50μm, core and cladding refractive indices 1.41 and 1.4 at wavelength 820 nm. **(05 Marks)**

7 a. Choose your answers for the following : **(04 Marks)**

i) A crystal of tetragonal lattice has

A) $a = b = c$ B) $a \neq b \neq c$ C) $a = b \neq c$ D) $a \neq b = c$

ii) The relation between atomic radius r and lattice constant a in FCC structure is

A) $a = 2R$ B) $a = 2\sqrt{2}\,R$ C) $a = \frac{\sqrt{3}}{4}R$ D) $a = \frac{4}{\sqrt{3}}R$

iii) Packing factor of diamond crystal is

A) 34% B) 52% C) 68% D) 74%

iv) Which of the following unit cells is a primitive cell?

A) Simple cubic B) bcc C) FCC D) None of these

b. Derive an expression for interplanar spacing in a cubic system. **(05 Marks)**

c. Explain how Bragg's spectrometer is used for determination of interplanar spacing in a crystal. **(06 Marks)**

d. Calculate the energy of electron that produces Bragg's diffraction of first order at glancing angle of 22^o when incident on crystal with interplanar spacing of 1.8 A^o. **(05 Marks)**

8 a. Choose your answers for the following : **(04 Marks)**

i) The nanostructure reduced in only one direction is known as

A) quantum dot B) quantum wire

C) quantum well D) film

ii) Fullerene is a

A) molecule B) atom

C) chemical mixture D) nano particle

iii) Testing of a product without causing any damage is called

A) minute testing B) destructive testing

C) non-destructive testing D) random testing

iv) The signal due to a reflected wave is called

A) transmitted wave B) longitudinal wave

C) echo D) peaco

b. With simple illustration describe the two methods of preparation of nano materials. **(05 Marks)**

c. What are the potential applications of carbon nanotubes? **(05 Marks)**

d. Describe in brief a method of measuring velocity of ultrasonic waves in a liquid. **(06 Marks)**

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