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10PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2015/Jan.16
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: $m_e = 9.1 \times 10^{-31}$ kg, $m_n = 1.674 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ JS, $K_B = 1.38 \times 10^{-23}$ J/K, $\epsilon_0 = 8.854 \times 10^{-12}$ F/m, $N_A = 6.025 \times 10^{26}$/Kmol.***

PART – A

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

i) In black body radiation spectrum, with increase of temperature the maximum energy position shifts towards
A) shorter wavelength B) longer wavelength
C) no change D) none of these

ii) In Davisson and Germer's experiment, the first order diffraction maximum is observed when the angle between incident and reflected rays is
A) 45° B) 50° C) 90° D) 180°

iii) The electron accelerated by a potential difference 'V' volts, its wavelength 'λ' is equal to
A) $\frac{1.227}{\sqrt{V}}$ m B) $\frac{1.227}{\sqrt{V}}$ Å C) $\frac{1.227}{\sqrt{V}}$ nm D) $\frac{12.27}{V}$ m

iv) The phenomenon of increase in the wavelength of x-rays after scattering is called
A) photo emission B) Crompton effect
C) continuous spectrum D) Compton effect

b. Explain how de-Broglie hypothesis is verified experimentally, with conclusion. **(07 Marks)**

c. Derive de-Broglie wavelength in terms of group velocity. **(05 Marks)**

d. Calculate the momentum of the Particle and de-Broglie wavelength associated with an electron with a kinetic energy of 1.5 KeV. **(04 Marks)**

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

i) If the uncertainty in position of an electron is 4×10^{-10} m, the uncertainty in its momentum is
A) 1.319×10^{-25} kgm/s B) 1.319 kgm/s
C) 1.319×10^{-25} kg D) 1.319 nm

ii) The uncertainty in the determination of position of an electron is $[h/3\pi]$. Then, the uncertainty in the determination of its momentum is
A) 1/4 B) 3/4 C) 4/3 D) 3

iii) The eigen function for the first excited state is
A) $\psi_1 = A\sin\left[\frac{\pi}{a}\right]x$ B) $\psi_3 = A\sin\left[\frac{3\pi}{a}\right]x$
C) $\psi_2 = A\sin\left[\frac{2\pi}{a}\right]x$ D) none of these

iv) $\frac{h^2}{8ma^2}$ corresponds to quantized energy of a particle in
A) first excited state B) second excited state
C) third excited state D) ground state

b. State Heisenberg's uncertainty principle. And hence show the non existence of electrons inside the nucleus. **(05 Marks)**

c. Derive the time independent Schrodinger wave equation in case of a free particle. **(07 Marks)**

d. An electron is bound in one dimensional potential well of width 0.18 nm. Find the energy value in eV of the second excited state. **(04 Marks)**

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

i) Classical free electron theory assumes that the electrons in a metal form
A) electron gas B) liquid molecule
C) fixed lattice points D) none of these

ii) The drift velocity per unit electric field is called
A) acceleration B) mobility C) electric potential D) resistivity

iii) At T > 0K the probability of occupancy of Fermi level is
A) 75% B) 90% C) 50% D) 100%

iv) If the electrical conductivity of a metal is 6.49×10^7 /Ωm then its resistivity is
A) 0.154×10^{-8} Ωm B) 15.4×10^{-8} Ωm
C) 1.54 Ωm D) 1.54×10^{-8} Ωm

b. Based on classical free electron theory, derive an expression for electrical conductivity of metal. **(05 Marks)**

c. Explain the merits of quantum free electron theory. **(06 Marks)**

d. Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi energy is occupied. **(05 Marks)**

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

i) Spontaneous dielectric polarization can exist in the absence of an electric field such materials are called
A) Ferroelectrics B) Electrics
C) Magnetic D) Ferromagnetic

ii) The ratio of polarization per unit electric field is called
A) magnetic susceptibility B) electric susceptibility
C) susceptibility D) none of these

iii) Clausius-Mosotti equation is valid for
A) liquids B) polar materials C) non-polar solids D) none of these

iv) At a temperature above the curie point a ferromagnetic material becomes
A) magnet B) ferroelectric C) diamagnetic D) paramagnetic

b. Explain electronic, ionic and orientational polarizations. **(06 Marks)**

c. Explain characteristic properties and applications of hard and soft magnets. **(06 Marks)**

d. A solid dielectric material has electronic polarisability 7×10^{-40} F/m^2. If it is a cubic structure, calculate the relative permittivity of the material. It has 3×10^{28} atoms/m^3. **(04 Marks)**

PART – B

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

i) The following technique is not used to obtain population inversion
A) optical pumping B) optical activity
C) electrical pumping D) forward bias

ii) The life time of an atom in a metastable state is about
A) 10 ms B) 0.1 s C) 1 ms D) 10 ns

iii) The most relevant property involved in the cutting of metals by laser beam is
A) monochromaticity B) coherence
C) sharp focus D) high intensity

iv) The ratio of emission rate to the absorption rate is equal to
A) $\frac{N_2}{N_1}$ B) N_1N_2 C) $\frac{N_1}{N_2}$ D) N_2

b. Obtain an expression for energy density of radiation under thermal equilibrium interms of Einstein's coefficients. **(06 Marks)**

c. Describe the construction and working of semiconductor diode laser. **(06 Marks)**

d. A He-Ne gas laser is emitting a laser beam with an average power of 4.5 mW. Find the number of photons emitted per second by the laser. The wavelength of the emitted radiation is 6328 Å. **(04 Marks)**

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

i) The necessary minimum magnetic field required to destroy superconductivity is called
A) critical temperature B) critical field
C) Meissner effect D) none of these

ii) Super conductors are
A) paramagnetic B) ferromagnetic
C) diamagnetic D) antiferromagnetic

iii) Multimode graded index fiber is
A) reflective type B) diffractive type C) interference type D) refractive type

iv) Fractional index change for an optical fiber with core and cladding of refractive indices 1.41 and 1.40 respectively is
A) 0.00709 B) 0.709 C) 709 D) 0.0709

b. Explain in brief the BCS theory of superconductivity. **(06 Marks)**

c. Derive an expression for acceptance angle and numerical aperture interms of refractive indices of core and cladding. **(06 Marks)**

d. An optical glass fiber of refractive index 1.50 is to be clad with another glass to ensure internal reflection that will contain light travelling within 5° of the fiber axis. What maximum index of refraction is allowed for the cladding? **(04 Marks)**

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

i) The relation of angle between axes of a triclinic crystal system is
A) $\alpha = \beta = \gamma = 90°$ B) $\alpha \neq \beta \neq \gamma = 90°$ C) $\alpha \neq \beta = \gamma = 90°$ D) $\alpha = \beta = \gamma \neq 90°$

ii) The coordination number for face centred cubic lattice is
A) 8 B) 6 C) 12 D) 26

iii) The atomic radius for body centred cubic lattice is
A) $\frac{a}{2}$ B) $\frac{\sqrt{2}}{4}a$ C) $\frac{a}{4}$ D) $\frac{\sqrt{3}}{4}a$

iv) The longest wavelength that can be analysed by a crystal of spacing 2.82 Å in the first order is
A) 5.64 Å B) 56 Å C) 0.56 Å D) 564 Å

b. Explain in brief the seven crystal systems. **(07 Marks)**

c. Describe how Bragg's spectrometer is used to determine the wavelength of x-rays. **(05 Marks)**

d. Calculate the glancing angle for incidence of x-rays of wavelength of 0.58 Å on the plane (132) of NaCℓ which results in second order diffraction maxima taking lattice constant as 3.81 Å. **(04 Marks)**

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

i) A constant testing of product without causing any damage is called
A) minute testing B) non-destructive testing
C) destructive testing D) random testing

ii) The velocity of ultrasonic waves in a solid can be measured by the method of
A) interference B) echo C) pulse-echo D) refraction

iii) Which one of these does not represent a type of carbon nanotube
A) armchair B) wavy C) zig-zag D) arch discharge

iv) Carbon nanotubes are molecular structures of
A) graphene sheet B) graphite sheet C) plastic D) none of these

b. What are nano materials? Write a note on carbon nano tube. **(06 Marks)**

c. What is non destructive testing? Explain how flow in a solid can be detected by non-destructive method using ultrasonics. **(10 Marks)**

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