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10PHY12/22

First/Second Semester B.E. Degree Examination, December 2011

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. ***Physical constants : $c = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ JS, $e = 1.602 \times 10^{-19}$C, $m_e = 9.1 \times 10^{-31}$ kg, $N_A = 6.02 \times 10^{26}$/Kmole, $\epsilon_0 = 8.85 \times 10^{-12} Fm^{-1}$, $k = 1.38 \times 10^{-23} JK^{-1}$.***

PART – A

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

i) The wavelength (λ) associated with a particle of mass, m, moving with velocity V is given by

A) $\lambda = \frac{h}{mV}$ B) $\lambda = \frac{mV}{h}$ C) $\lambda = \frac{hV}{m}$ D) $\lambda = \frac{m}{hV}$

ii) The law which describes the blackbody radiation completely is

A) Planck's law B) Stefan's law
C) Wien's law D) Rayleigh-Jean's law

iii) Davisson and Germer experiment relates to

A) interference B) polarization
C) electron diffraction D) phosphorescence

iv) The group velocity of the particle is 3×10^6 m/s, whose phase velocity is

A) 6.06×10^6 m/s B) 3×10^{10} m/s
C) 3×10^6 m/s D) 1.5×10^{10} m/s

b. What is the matter wave? Derive an expression for de-Broglie wavelength using group velocity concept. **(05 Marks)**

c. Find the energy of the neutron in eV whose de-Broglie wavelength is 1Å. **(04 Marks)**

d. Describe Davisson and Germer experiment for the justification of de-Broglie hypothesis. **(07 Marks)**

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

i) The equation of motion of matter was derived by

A) Heisemberg B) Bohr C) de-Broglie D) Schroedinger

ii) The product of uncertainties between position and momentum is given by

A) $\Delta x\, \Delta p \geq \lambda$ B) $\Delta x\, \Delta p \geq \frac{\hbar}{2}$ C) $\Delta x\, \Delta p \geq mV$ D) $\Delta x\, \Delta p \geq n\hbar$

iii) Which of the following functions cannot be accepted as solutions for Schroedinger's time independent equation for all values of x?

A) $a \sin x$ B) $a \cos x$ C) $a \sec x$ D) $a \sin x + b \cos x$

iv) The energy corresponding to the first permitted energy level for a particle in an infinite potential well is called

A) excited energy B) zero point energy
C) meta stable state energy D) none of these.

2 b. Obtain the time independent Schroedinger wave equation. **(07 Marks)**

c. An electron is confined to a box of length 10^{-9} m, calculate the minimum uncertainty in its velocity. **(05 Marks)**

d. Show that electrons cannot exist in the nucleus of an atom. **(04 Marks)**

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

i) For ordinary metals, the resistivity verses temperature curve at T = 0 K
A) has a positive intercept B) has a negative intercept
C) goes through the origin D) none of these

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

iii) If the mobility of electron in a metal increases, the resistivity
A) decreases B) increases
C) remains constant D) none of these

iv) The dependence of mean free path λ on temperature T is
A) $\lambda \alpha T$ B) $\lambda \alpha \sqrt{T}$
C) $\lambda \alpha \frac{1}{T}$ D) $\lambda \alpha \frac{1}{\sqrt{T}}$

b. Using the free electron theory, derive an expression for electrical conductivity in metals. **(05 Marks)**

c. Explain Fermi energy and Fermi factor. **(06 Marks)**

d. Calculate the Fermi velocity and the mean free path for the conduction electrons in silver, given that its Fermi energy is 5.5 eV and the relaxation time for electrons is 3.97×10^{-14} s. **(05 Marks)**

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

i) Electronic polarization _____.
A) increases with temperature B) decreases with temperature
C) independent of temperature D) none of these

ii) The polarization produced in a dielectric medium of relative permittivity 16 in presence of an electric field of 500 V/m is ____.
A) $7500 \in_0$ B) $1500 \in_0$
C) $1600 \in_0$ D) none of these

iii) The susceptibility of a dielectric depends on
A) intensity of the applied field
B) the dielectric polarization
C) the ratio of dielectric polarization and the intensity of the applied field
D) the ratio of the intensity of the applied field and the dielectric polarization.

iv) Piezoelectric effect is used to convert _____ energy into _____ energy.
A) mechanical, electrical B) electrical, mechanical
C) thermal, electrical D) none of these

b. Define dielectric polarization. Discuss different types of polarization mechanisms. **(07 Marks)**

c. The dielectric constant of sulphur is 3.4. Assuming a cubic lattice foe its structure, calculate the electric polarizability of sulphur. Given density = 2.07×10^3 kg/m^3 and at weight = 32.07. **(05 Marks)**

d. Distinguish between hard and soft magnetic materials. **(04 Marks)**

PART – B

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

i) Emission of a photon by an excited atom due to interaction of external energy is called
A) spontaneous emission B) stimulated emission
C) induced absorption D) light amplification.

ii) Pumping process used in diode laser is
A) optical pumping B) forward bias
C) electrical discharge D) none of these

iii) Image is stored on a hologram in the form of
A) interference pattern B) diffraction pattern
C) photography D) none of these

iv) Important characteristic of laser beam is
A) interference B) diffraction C) dispersion D) coherence

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

c. Describe the recording and reconstruction process in holography, with the help of suitable diagrams. **(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 $\mathring{A}$. **(04 Marks)**

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

i) The numerical aperture of an optical fibre of which refractive indices of the core and cladding are 1.563 and 1.498, is
A) 0.446 B) 1.043 C) 0.958 D) none of these

ii) Attenuation is the _____ in power of light as it travels in the fibre.
A) amplification B) reduction C) gain D) none of these

iii) The superconductor behaves like a perfect
A) paramagnet B) Ferro magnet C) diamagnet D) none of these

iv) Below critical temperature, if the temperature of superconductor is increased, the critical field
A) increases B) decreases
C) remains constant D) first increases, then decreases

b. Discuss Meissner effect. **(05 Marks)**

c. Obtain and expression for the numerical aperture. **(05 Marks)**

d. The refractive indices of the core and cladding of a step index optical fibre are 1.45 and 1.40 respectively and its care diameter is 45 μm. Calculate its relative refractive index difference, V-number at wavelength 1000 nm and the number of modes. **(06 Marks)**

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

i) The number of atoms per unit cell in diamond is
A) 1 B) 2 C) 4 D) 8

ii) Miller indices of a plane parallel to X and Y axes are
A) (0 0 1) B) (1 0 0) C) (0 1 0) D) (1 1 0)

7 a. iii) In a Bragg's X-ray spectrometer, for every rotation θ of the turn table, the ionization chamber turns by an angle of

A) θ B) 2θ C) 3θ D) 4θ

iv) The grating space of calcite is 3.036 Å and for the first order Bragg reflection, the glancing angle is 12°. The path difference between the rays is

A) 0.63 Å B) 6.3 Å C) 1.262 Å D) 12.62 Å

b. Explain in brief the seven crystal systems, with neat diagrams. **(07 Marks)**

c. Monochromatic X-rays of wavelength 0.82 Å undergo first order Bragg reflection from a crystal of cubit lattice with lattice constant 3 Å at a glancing angle of 7.855 Å. Identify the possible planes which give rise to this reflection in terms of their Miller indices. **(06 Marks)**

d. Derive Bragg's equation. **(03 Marks)**

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

i) The bulk material reduced in two direction is known as

A) quantum dot B) quantum wire

C) film D) reduced structure

ii) The state of matter around the nano size is known as

A) solid state B) liquid state

C) plasma state D) mesoscopic state

iii) Ultrasonic waves can exist as longitudinal waves in

A) solids B) liquids C) gases D) all of these

iv) The elastic behaviour of a liquid is characterized by its

A) Young's modulus B) modulus of rigidity

C) bulk modulus D) Poisson's ratio

b. Describe with simple illustrations, the two methods of preparation of nanomaterial. **(08 Marks)**

c. What are ultrasonics? Describe a method of measuring velocity of ultrasonics waves in solids. **(08 Marks)**

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