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10PHY12/22

First/Second Semester B.E. Degree Examination, June/July 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 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 :* *Planck's constant,* $h = 6.63\times10^{-34}$ *Js,* *Electron charge,* $e = 1.6\times10^{-19}$ *C*
Electron mass, $m = 9.11\times10^{-31}$ *kg,* *Velocity of light,* $C = 3\times10^{8}$ mS^{-1}

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

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

i) If red and blue stars emits radiations of continuous wavelengths, then according to Wien's displacement law.
A) Blue star is hotter than red star B) Red star is hotter than blue star
C) Both stars are at same temperature D) Difficult to conclude.

ii) The expression for de-Broglie wavelength for an electron under an accelerating potential V is,
A) $\frac{12.26}{\sqrt{V}}$ m B) $\frac{12.26}{\sqrt{V}}$ A° C) $\frac{12.26}{\sqrt{V}}$ nm D) $\frac{12.26}{\sqrt{V}}$ μm

iii) A particle moves with velocity 3×10^{6} ms^{-1}. The wavelength associated with it is 1 nm. Then group velocity of the particle is,
A) 3×10^{8} mS^{-1} B) 3×10^{10} mS^{-1} C) 3×10^{6} mS^{-1} D) 1.5×10^{6} mS^{-1}

iv) According to the Compton effect, the wavelength of X-rays scattered at an angle greater than zero,
A) Decreases B) Doesn't change C) Increases D) None of these

b. Derive an expression for group velocity on the basis of superposition of waves. Also obtain the relation between group velocity and phase velocity. **(08 Marks)**

c. Show that Planck's law reduces to Wien's law and Rayleigh-Jeans law under certain conditions. **(05 Marks)**

d. Calculate the de-Broglie wavelength associated with an electron of energy 1.5 eV. **(03 Marks)**

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

i) The energy of the lowest state in one dimensional potential box of length a = 1 unit is,
A) $\frac{h^2}{8m}$ B) zero C) $\frac{h^2}{4ma^2}$ D) $\frac{h^2}{2ma^2}$

ii) For a particle which is not bound to any system and is free, the energy eigen value is,
A) zero B) finite but not quantized
C) infinity D) finite but quantized

iii) If the uncertainty in the position of a particle is equal to its de-Broglie wavelength then uncertainty in its momentum will be,
A) $\Delta P \geq \frac{h}{4\pi}$ B) $\Delta P \geq \frac{h}{2\pi}$ C) $\Delta P \geq \frac{P}{4\pi}$ D) $\Delta P \geq \frac{h}{P}$

iv) For an electron to be present inside the nucleus of an atom the uncertainty in the position of the electron must be,
A) more than or equal to the radius of the nucleus
B) more than or equal to the diameter of the nucleus.
C) more than the diameter of the nucleus
D) less than or equal to the diameter of the nucleus.

2 b. Using time independent Schrodinger's wave equation, obtain the expression for the normalized wave function for a particle in one dimensional potential well of infinite height. **(08 Marks)**

c. State Heisenberg's uncertainty principle. Write its physical significance. **(04 Marks)**

d. A spectral line of wavelength 5461 $\mathring{A}$ has a width of 10^{-4} $\mathring{A}$. Evaluate the minimum time spent by the electrons in the upper energy state. **(04 Marks)**

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

i) In the following the ohm's law is,

A) $J = \sigma E$ B) $J = \frac{\sigma}{E}$ C) $J = \sigma E^2$ D) $J = \frac{E}{\sigma}$

ii) Mobility of electron is,
A) Reciprocal of conductivity
B) Average electrons drift velocity per unit electric field.
C) Flow of electrons per unit cross sectional area.
D) Reciprocal of resistivity

iii) 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) $\lambda \alpha \frac{1}{\sqrt{T}}$

iv) According to free electron theory, the free electrons are treated as,
A) Rigidity fixed lattice points B) Liquid molecules
C) Gas molecule D) None of these

b. Define Fermi energy and Fermi factor. Discuss the variation of fermifactor with temperature and energy. **(08 Marks)**

c. What is mean collision time? Using free electron theory in a metal, obtain an expression for electrical conductivity in terms of mean collision time. **(06 Marks)**

d. State and explain Matthiessen's rule. **(02 Marks)**

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

i) Electronic polarization,
A) Independent of temperature B) Increases with temperature
C) Decreases with temperature D) None of these

ii) The correct relation among the following 4 equations is,

A) $E = \varepsilon_0(\varepsilon_r - 1)P$ B) $P = \varepsilon_0(\varepsilon_r - 1)E$ C) $\varepsilon_r = \chi - 1$ D) $D = \varepsilon_0(\varepsilon_r - 1)E$

iii) For Ferromagnetic substances, the Curie-Wiess law is given as,

A) $\epsilon_r = \frac{C}{T}$ B) $\epsilon_r = \frac{T-\theta}{C}$ C) $\epsilon_r = \frac{C}{(T-\theta)}$ D) $\epsilon_r = \frac{C}{(T+\theta)}$

iv) In the inverse piezoelectric effect,
A) Ultrasonic waves are produced B) Electromagnetic waves are produced
C) Microwaves are produced D) None of these

b. What is internal field? Derive an expression for internal field in case of one dimensional array of atoms in dielectric solids. **(08 Marks)**

c. Describe magnetic hysteresis in Ferromagnetic material. **(05 Marks)**

d. Explain any three applications of piezoelectric material. **(03 Marks)**

PART – B

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

i) The pumping action in diode laser is by,

A) Optical pumping B) Electrical discharge C) Reverse bias D) Forward bias

ii) The expression for energy density in terms of Einstein's coefficients,

A) $U_\gamma = \frac{B}{A}\left[\frac{1}{e^{h\gamma/KT}-1}\right]$ B) $U_\gamma = \frac{A}{B}\left[\frac{1}{1-e^{h\gamma/KT}}\right]$

C) $U_\gamma = \frac{A}{B}\left[\frac{1}{e^{h\gamma/KT}-1}\right]$ D) $U_\gamma = \frac{A}{B}\left[e^{h\gamma/KT}-1\right]$

iii) In order to see the image of an object recorded by holography.

A) It is enough if we just have the hologram.

B) We need the hologram and the reference beam.

C) We need the hologram, the reference beam and the object beam.

D) We need the hologram, the reference beam and the object beam as well as the object.

iv) In a laser system when the energy difference between two energy levels is 2×10^{-19} J, the average power output of laser beam is found to be 4 mw. Then number of Photons emitted per second is,

A) 2×10^{16} B) 2×10^{-16} C) 0.5×10^{16} D) 2×10^{19}

b. Describe the construction of He-Ne laser and explain its working with the help of energy level diagram and mention few applications. **(08 Marks)**

c. Explain the terms spontaneous emission and stimulated emission. **(04 Marks)**

d. Explain laser welding and cutting process with diagrams. **(04 Marks)**

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

i) Superconductors are

A) Ferromagnetic B) Paramagnetic C) Antiferromagnetic D) Diamagnetic

ii) All high temperature superconductors are different types of oxides of,

A) Mercury B) Lead C) Copper D) Tin

iii) The quantum of magnetic flux is given by,

A) $\frac{2e}{h}$ B) $\frac{h}{2e}$ C) $\frac{he}{2}$ D) $\frac{2h}{e}$

iv) Numerical aperture of an optical fiber depends on,

A) Acceptance angle B) Diameter of the fiber C) Critical angle D) None of these

b. Discuss point to point optical fiber communication system and mention its advantages over the conventional communication systems. **(06 Marks)**

c. Define superconductivity and explain Type I and Type II superconductors. **(06 Marks)**

d. The angle of acceptance of an optical fiber is 30° when kept in air. Find the angle of acceptance when it is in a medium of refractive index 1.33. **(04 Marks)**

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

i) A crystal of hexagonal lattice has unit cell with sides,

A) $a \neq b \neq c, \alpha = \beta = 90°, \gamma = 120°$ B) $a = b = c, \alpha = \beta = 90°, \gamma = 120°$

C) $a \neq b = c, \alpha = \beta = \gamma = 90°$ D) $a = b \neq c, \alpha = \beta = 90°, \gamma = 120°$

ii) In Bragg's spectrometer, for every rotation θ of the turn table, the detector turns by an angle,

A) θ B) 4θ C) 2θ D) $\frac{\theta}{2}$

iii) The interatomic distance between the sodium and chlorine atoms in sodium crystal is,

A) 5.68 Å B) 2.81 Å C) 6.62 Å D) 5.51 Å

iv) The interplanar spacing in a crystal is 1 Å and the glancing angle is 35°. For the first order Bragg reflection to take place, the wavelength of X-rays is,

A) 1.147 Å B) 0.573 Å C) 1.638 Å D) 0.819 Å

b. What are Miller indices? Explain the procedure to find Miller indices with an example. **(05 Marks)**

c. Obtain the expression for interplanar spacing interms of 'a' for a cubic lattice. **(05 Marks)**

d. Calculate the atomic packing factor for SC, FCC and BCC lattices. **(06 Marks)**

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

i) An acoustic grating can be made by,

A) Drawing lines on a glass plate

B) Subjecting an optical grating to pressure waves of ultrasonic frequency

C) It is only theoretical concept.

D) Setting up a standing waves pattern in a liquid using ultrasonic.

ii) The velocity of ultrasonic wave through the liquid increases as,

A) Bulk modulus decreases B) Density decreases

C) Bulk modulus increases D) Volume increases

iii) The minimum size of matter below which the properties becomes size dependent is called,

A) Pico size B) Nano size C) Micro size D) Macro size

iv) The number of carbon atoms present in C_{60} molecule is,

A) 60 B) 32 C) 20 D) 12

b. Describe with simple illustrations, the two methods of preparation of nano materials. **(06 Marks)**

c. Describe a method of measuring velocity of ultrasonic waves in solids. Using this how you can find the rigidity modulus of the solid. **(06 Marks)**

d. Explain quantum structures. **(04 Marks)**

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