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10PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2017
Engineering Physics

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, choosing at least two from each part.*
2. *Physical constants:* $h = 6.625 \times 10^{-34}$ *J-S,* $C = 3\times10^{8}\ ms^{-1}$, $m_e = 9.1\times10^{-31}kg$, $L = 1.38\times10^{-23}Fm^{-1}$, $\in_0 = 8.854 \times 10^{-12}Fm^{-1}$, $e = 1.6\times10^{-19}C$, *Avogadro number* $N_A = 6.025\times10^{26}/K$ *mole.*

PART – A

1 a. Choose the correct answers for the following :

i) The associated wavelength of an electron beam is acceleration from rest through a potential difference of 200V is

A) 0.868 Å B) 0.0868 Å C) 0.969 Å D) 0.0969 Å

ii) In blackbody radiation spectrum, with increase of temperature the maximum intensity position shift towards.

A) Shorter wavelength B) longer wavelength
C) Entire wavelength D) no change.

iii) Davisson and Germer succeeded in their experiment in proving

A) Bragg's law B) Particle nature of electrons
C) Wave nature of electrons D) That nickel is a crystal

iv) Einstein's photo electric equation is given by

A) $\frac{1}{2}mV_{max}^2 = h\gamma - \phi$ B) $\frac{1}{2}mV_{max}^2 = h\gamma + \phi$ C) $\frac{1}{2}mV_{max}^2 = h\gamma - h_1$ D) None of these

(04 Marks)

b. What is Plank's radiation law? Show that Planck's law reduces to Wien's law and Rayleigh Jeans law. **(06 Marks)**

c. Define phase velocity and group velocity and derive a relation between them. **(06 Marks)**

d. Estimate the potential difference through which a proton is needed to be accelerated so that its de Broglie wavelength becomes equal to 1 Å, given mass of proton is 1.673×10^{27}kg. **(04 Marks)**

2 a. Choose the correct answers for the following :

i) The energy required for an electron to jump from ground state to the second excited state in a potential well of width L is

A) $E = \frac{h^2}{mL^2}$ B) $E = \frac{h^2}{4mL^2}$ C) $E = \frac{h^2}{8mL^2}$ D) $\frac{2h^2}{mL^2}$

ii) According to max Born's interpretation, $|\psi|^2$ represents

A) probability density B) Energy density
C) Particle density D) Charge density.

iii) A wave function is an acceptable wave function if it is

A) Finite every where B) Continuous every where
C) Single valued every where D) All of these.

iv) If the uncertainty in momentum is large, the uncertainty in wavelength is

A) Small B) Large C) Zero D) None of these

(04 Marks)

b. Obtain the time independent Schrödinger wave equation, in one dimension. **(07 Marks)**

c. State and explain Heisenberg's uncertainty principle. **(04 Marks)**

d. An electron and a 150×10^{-3}Kg base ball are travelling at a velocity of 220m/s, measured to an accuracy of 0.005%. Calculate uncertainty in position of each. **(05 Marks)**

3 a. Choose the correct answers for the following :

i) The free electrons in classical free electron theory are treated as

A) rigidly fixed lattice points B) Gas molecules

C) Liquid molecules D) None of these.

ii) The electron mobility in a solid is

A) $\mu = \frac{V_d}{E}$ B) $\mu = V_d E$ C) $\mu = \frac{V_d}{L}$ D) $\mu = V_d L$

iii) The Fermienergy of a metal at absolute zero temperature is proportional to

A) $n^{1/3}$ B) $n^{3/2}$ C) $n^{2/3}$ D) n^2

iv) The collision time and root mean square velocity of an electron at room temperature are 3×10^{-14} s and 1×10^{5} m/s respectively. The classical value of mean free path of the electron is

A) 3×10^{-19}m B) 3×10^{-10}m C) 3×10^{-9}m D) 3×10^{19}s

(04 Marks)

b. Using the free electron theory, derive an expression for electrical conductivity in metals. **(06 Marks)**

c. Discuss the dependence of Fermic factor on temperature. **(06 Marks)**

d. Calculate the Fermienergy of sodium at 0K assuming that it has one free electron per atom and density of sodium is 970kg/m^3 and atomic weight 23. **(04 Marks)**

4 a. Choose the correct answers for the following :

i) If the radius of hydrogen atom is 0.053×10^{-9}m, then its electronic polarizability is

A) 1.656×10^{-41}Fm^2 B) 3.035×10^{-40}Fm^2 C) 5.9×10^{-21}Fm^2 D) 16.56×10^{-41}Fm^2

ii) The polarization mechanism that depends on temperature is

A) Electronic B) ionic C) orientational D) Space charge

iii) The relative permeability for diamagnetic materials is

A) > 1 B) < 1 C) = 1 D) Zero

iv) Piezoelectric effect is used to convert ____energy into _____energy.

A) Mechanical, electrical B) Electrical, mechanical

C) Electrical, light D) None of these. **(04 Marks)**

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

c. Compare soft and hard magnetic materials on the basis of hysteresis curve, Give example and applications for each type. **(05 Marks)**

d. The dielectric constant of sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of sulphur. The atomic weight and density of suplhur are 32.07 and 2.07×10^3 kg/m^3 respectively. **(04 Marks)**

PART – B

5 a. Choose the correct answers for the following :

i) The ratio of Einstein's spontaneous and stimulated emission coefficients is

A) $\frac{8\pi h\lambda^3}{C^3}$ B) $\frac{8\pi h\gamma^3}{C^3}$ C) $\frac{8\pi h\gamma^2}{C^2}$ D) $\frac{8\pi h\lambda^2}{C^2}$

ii) The process of producing population inversion is known as

A) absorption B) emission C) pumping D) None of these

iii) Active centre of He –Ne gas loses
A) Ne B) He C) Bothe Ne and He D) None

iv) Image is stored on a hologram in the form of
A) interference pattern B) diffraction pattern
C) polarization D) photography **(04 Marks)**

Describe the construction and working of He-Ne laser. **(07 Marks)**

b. What is holography? Explain the recording process in holography. **(05 Marks)**

c. A He-Ne laser emits photons of wavelength 632.8nm with 1mW average power per pulse.

d. Calculate the number of photons emitted per second. **(04 Marks)**

6 a. Choose the correct answers for the following :

i) In an Optical fibre, the core material has refractive index 1.43 and refractive index of clad material is 1.4, the numerical operator is
A) 0.92 B) 0.29 C) 0.97 D) 0.77

ii) The relation between numerical aperture and fractional index change is
A) $NA = n_1\sqrt{2\Delta}$ B) $NA = \Delta\sqrt{2n_1}$ C) $NA = \Delta n_1\sqrt{2n_1}$ D) $NA = 2n_1\sqrt{\Delta}$

iii) The variation of critical field H_c with temperature T is given by

A) $H_c = H_o\left[1-\left(\frac{T}{T_c}\right)^2\right]$ B) $H_c = H_o\left[1+\left(\frac{T}{T_c}\right)^2\right]$

C) $H_c = H_o\left[1-\left(\frac{T}{T_c}\right)\right]$ D) $H_c = H_o\left[1+\left(\frac{T}{T_c}\right)\right]$

iv) Superconductors in superconducting state behaves as
A) Ferromagnetic material B) Diamagnetic materials
C) Dielectric material D) Monovalent material. **(04 Marks)**

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

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

d. A step index optical fibre has a core index of 1.46 and the cladding index of 1.409. If the core diameter is 80μm, and the wavelength of light source is 1.2μm, determine the number of modes present in the fibre. **(04 Marks)**

7 a. Choose the correct answers for the following :

i) Lead exhibits FCC structure. Each side of the unit cell is of 4.95 Å, the radius of a lead atom is
A) 1.75 Å B) 1.57 Å C) 1.075 Å D) 1.057 Å

ii) The miller indices of the place parallel to X and Y axes are
A) (100) B) (010) C) (001) D) (111)

iii) The lattice constant of a cubic crystal is given by

A) $a = d_{hk\ell}\sqrt{h^2+k^2+\ell^2}$ B) $a = \frac{d_{hk\ell}}{\sqrt{h^2+k^2+\ell^2}}$

C) $a = \frac{\sqrt{h^2+k^2+\ell^2}}{d_{hk\ell}}$ D) None of these.

iv) The grating space of calcite is 3.036 Å. The wavelength of X-rays that undergo first order reflection at a glancing angle of 12° is
A) 1.262 Å B) 1.626 Å C) 1.541 Å D) 1.145 Å
(04 Marks)

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

c. Describe how Bragg's X-ray spectrometer is used to determine the wavelength of an X-ray beam. **(06 Marks)**

d. Monochromatic X-rays of wavelength 0.82 Å undergo first order Bragg reflection from a crystal of cubic lattice with lattice constant 3 Å , at a glancing angle of 7.855°. Indentify the possible planes which give rise to this reflection in terms of their miller indices. **(05 Marks)**

8 a. Choose the correct answers for the following :

i) The nanostructure reduced in only one direction is known as
A) quantum dot B) Quantum wire C) film D) Quantum will

ii) The signal due to a reflected wave is called
A) transmitted wave B) longitudinal wave C) echo D) peaco

iii) The elastic behavior of a liquid is characterized by its
A) Young's modulus B) Bulk modulus
C) Rigidity modulus D) Poisson's ratio

iv) An acoustic grating can be made by
A) Setting up a standing wave pattern in a liquid using ultrasonic's
B) Subjecting an optical grating to pressure waves of ultrasonic frequency.
C) Drawing lines on a glass plate at equal width
D) It is only a theoretical concept. **(04 Marks)**

b. Write a note on nanotechnology. **(04 Marks)**

c. Write a note on fullerene with applications. **(06 Marks)**

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

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