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10PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2014

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 : Velocity of light, c = 3 x 10 ^{8} m/s
Planck's constant, h = 6.625x 10 $^{-34}$.I.S.
Charge on electron, e =1.602 x 10 ^{49}C
Mass of electron, m = 9.1 x 10 ^{41} kg
Avagadro number, NA = 6.02 x 10^{26}/k mole
Permittivity of vacuum, eo = 8.85 x 10^{42} F/m
Boltzmann constant, k = 1.38 x 10 $^{-23}$.14.

PART — A

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

i) If an electron, proton, neutron and a - particle have the same velocity, the particle which has the largest wavelength is
A) electron B) proton C) neutron D) a - particle

ii) The Compton shift for the back scattered photon is
A) $\frac{h}{m_o e}$ B) $\frac{2}{m_o e}$ C) $\frac{h}{2m_o e}$ D) $\frac{2h}{3m_o e}$

iii) The photoelectric effect is observed only if the wavelength of light is
A) above threshold wavelength B) below threshold wavelength
C) zero D) equal to threshold wavelength

iv) The law which failed to account for longer wavelength of blackbody radiation spectrum is
A) Wein's law B) Rayleigh-Jean's law
C) Plank's law D) Maxwell's law

b. Describe photoelectric effect along with Einstein's explanation. **(06 Marks)**

c. Describe Davisson and Germer experiment for confirmation of de-Broglie hypothesis. **(07 Marks)**

d. Calculate the kinetic energy of an electron of wavelength 18 nm {h = 6.63 x 10^{-34}, m_e = 9.11 x 10^{31} kg]. **(03 Marks)**

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

i) From the Heisenberg's uncertainty relation, AL.A0 $\frac{h}{4rt}$, L refers to
A) length B) linear displacement
C) angular displacement D) angular momentum

ii) The first excited state energy of a particle of mass m in a box of width 'a' is given by
A zero B) $\frac{h^2}{8ma^2}$ C) $\frac{2h^2}{8ma^2}$ D) $\frac{h^2}{2ma^2}$

iii) Wave function associated with a material particle is
A) single valued B) finite C) continuous D) all of these

iv) If the uncertainty in momentum is large, the uncertainty in energy is
A) small B) large C) zero D) independent

b. Obtain the time indeperu ye equation for a particle in one-dimensional potential well of infinite height and discuss the eigen values. **(09 Marks)**

c. What is Heisenberg's uncertainty principle? Discuss its significance. **(03 Marks)**

d. An excited atom has an average life time of 10^{-8} seconds. During this period, it emits a photon and returns to the ground state. What is the minimum uncertainty in the frequency of this photon? **(04 Marks)**

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

i) The Fermi temperature is given by

A) $\frac{2}{3}\frac{E_F}{K}$ B) $\frac{3}{2}\frac{E_F}{K}$ C) E_F D) 2E

ii) If the mobility of an electron in a metal increases, the resistivity

A) decreases B) increases C) remains constant D) none of these

iii) The Fermi energy of a metal at absolute zero temperature is proportional to (n - number of free electrons per unit volume).

A) n B) n^{32} C) $n^{3/3}$ D) n^2

iv) The electron energies in classical free electron theory follow

A) Maxwell-Boltzmann statistics B) Fermi-Dirac statistics

C) Bose-Einstein statistics D) none of these

b. Explain the failures of classical free electron theory. **(06 Marks)**

c. Explain Fermi-energy and Fermi-factor. Discuss the probability of occupation of various energy states by electron at T=0°K and T > 0°K on the basis of Fermi factor. **(06 Marks)**

d. Calculate the mobility and relaxation time of electron in copper assuming that each atom contributes one free electron for conduction. Given resistivity of copper = 1.73×10^{-8} ohm-m. At. weight = 63.5, density = 8.92×10^3 kg/m^3, **NA** = 6.02×10^{26}/kg mole. **(04 Marks)**

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

i) Copper is

A) diamagnetic material **B)** paramagnetic material

C) ferromagnetic material D) antiferromagnetic material

ii) Electronic polarization

A) increases with temperature **B)** decreases with temperature

C) independent of temperature D) none of these

iii) The unit of dipole moment per unit volume is

A) coulomb/metre B) coulomb/metre^2

C) coulomb/metre^3 D) coulomb

iv) The electric susceptibility x =

A) ε_0 EP B) $\frac{E}{\varepsilon_0}$ C) $\frac{E}{\varepsilon_0 E}$ D) $\frac{P}{\varepsilon_0 E}$

b. Describe the different polarization mechanism. **(08 Marks)**

c. Explain hysteresis of ferroelectrics. **(05 Marks)**

d. If a NaCit crystal is subjected to an electric field of 1 KV/m and the resulting polarization is 4.3×10^{-8} c/rn^2. Calculate the dielectric constant of NaC9.. [E0 = 8.85×10^{-12} Fin $^{-1}$].**(03 Marks)**

PART – B

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

i) The life time of an atom on a metastable state is of the order

A) a few seconds B) unlimited C) a nano second D) few millisecond

The ratio of Einstein _ __. _..........._....-. _ .._.. B is

A) &EU.' / C^3 B) 87th / C^3 C) $87thy^3$ / C^3 $87chy^3$ / C^2

Holography records

A) only amplitude B) only phase

C) both amplitude and phase D) neither amplitude nor phase

Pumping process in a diode laser is by

A) optical pumping B) forward bias C) electric discharge D) none of these

b. Explain the construction and working of a He-Ne lase r. **(07 Marks)**

c. Explain the principle of holography and mention its a pplications. **(05 Marks)**

d. Find the ratio of populations of two energy levels in a laser if the transition between them produces light of wavelength 6493 A , assuming the ambient temperature as 27°C. [K = 1.38 x 10^{-23} PK]. **(04 Marks)**

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

i) If the angle of incidence of a ray is equal to the critical angle at the interface of core an cladding, then the ray travels

A) in the cladding B) in the core

C) along the interface D) in the buffer

ii) Fractional index change for the optical fibre of refractive index core and cladding 1.68 and 1.56 is

A) 0.0769 B) 0.0714 C) 1.0769 D) 0.9286

iii) A type II superconductor in the vortex state show

A) complete Meissner effect and zero electrical resistivity

B) incomplete Meissner effect and zero electrical resistivity

C) complete Meissner effect and non-zero electrical resistivity

D) incomplete Meissner effect and non-zero electrical resistivity

iv) Below the critical temperature, if the temperature of superconductor is increased, the critical field

A) increases B) decreases C) remains constant D) independent

b. What is attenuation? Explain the various mechanisms through which attenuation takes place. **(07 Marks)**

c. Explain type-I and type-II superconductors. **(05 Marks)**

d. The numerical aperture of an optical fibre is 0.2 when surrounded by air. Determine the RI of its core, given the RI of the cladding is 1.59. Also find the acceptance angle when the fibre is in water of RI 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#b#c, a#(3#y# 90° B) a = b = c, a —13 = = 90°

C) a b = c, a =13 = 120°, y=90° D) a = b c, cc =13 = 90°, y = 120°

ii) A plane intercepts at a, $\frac{b}{2}$, 2c in a simple cubic unit cell. The miller indices of the plane are

A) (2 1 4) B) (2 4 I) C) (4 2 1) D) (1 2 4)

iii) The coordination number in face centered cubic cell is

A) 2 B) 6 C) 8 D) 12

iv) In the Bragg's equal - he angle 0 is

A) the angle between the incident beam and the diffracted X-ray beam.

B) the angle between the incident beam and the normal to the diffraction planes

C) the angle between the incident beam and the diffraction planes

D) none of these.

b. Define packing factor. Calculate the packing factor for sc, bcc and fcc structures. **(07 Marks)**

c. Describe the construction and working of a Bragg's X-ray spectrometer. **(06 Marks)**

d. Draw the following planes in a cubic unit cell:

i) (2 0 0) ii) (2 1 0) iii) (1 3 2) **(03 Marks)**

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

i) Carbon nanotubes are made up of

A) graphene B) mica sheet layers

C) honey comb D) plastic

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) The elastic behaviour of a liquid is characterized by its

A) Young's modulus B) Rigidity modulus

C) Bulk modulus D) Poisson's ratio

iv) Ultrasonic waves are produced by

A) electromagnetic induction B) electric tuning fork

C) piezo electric effect D) inverse piezo electric effect

b. Write a note on fullerence. What are the applications of fullerences. **(08 Marks)**

c. Explain with principle, how the flaw in a solid can be detected by non-destructive method using ultrasonics. **(08 Marks)**