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10PHY12/22

First/Second Semester B.E. Degree Examination, Aug./Sept.2020
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 : Velocity of light*** $C = 3 \times 10^8$ ***m/s*** $^{-1}$ ***,***
Planck's constant $h = 6.625 \times 10^{-34}$ ***J-S , Avogadro number*** $N_A = 6.02 \times 10^{26}$ ***/Kmole ,***
Permittivity of Vaccum $\in_0 = 8.85 \times 10^{-12}$ ***F.M ,***
Boltzmann constant $K = 1.38 \times 10^{-23}$ ***J/K , Mass of Electron*** $m = 9.11 \times 10^{-31}$ ***kg ,***
Electron charge $e = 1.6 \times 10^{-19}$ ***C.***

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) Compton shift depends on
A) Tangent material B) Intensity of incident radiation
C) Angle of scattering D) Angle of incidence of incident radiation

ii) Stopping potential depends on
A) Frequency of incident radiation B) Intensity of incident radiation
C) Threshold frequency of the target D) None of these

iii) The most accurate law of radiation is
A) Wien's distribution law B) Rayleigh Jean's law
C) Planck's law D) None of these

iv) Debroglie wavelength of 100 ev electron is equal to
A) 1.22 $\mathring{A}$ B) 1.22 nm C) 12.2 $\mathring{A}$ D) 12.2nm.

b. Derive an expression for De-Broglie's wavelength using the expression of group velocity. **(06 Marks)**

c. Define group velocity and show that amplitude of a wave packet formed due to super position of two waves is periodic function in x and t. **(06 Marks)**

d. Find the kinetic energy of an electron whose De – Broglie wavelength is same as that of 100 Kev X - ray. **(04 Marks)**

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

i) One dimensional time independent Schrodinger wave equation is
A) Second order , ordinary and linear differential equation is x
B) Second order, partial and linear differential equation in x
C) First order , Ordinary and non – linear differential equation
D) None of these

ii) An eigen function should be
A) Single valued and continuous B) Multivalued and continuous
C) Multivalued and Finite D) None of these

iii) A normalized wave function means
A) Sum total of probability is 1 B) Sum total of probability is zero
C) Sum total of probability is infinite D) None of these

iv) The eigen function of a particle confined in 1 – D infinite potential well, which is I^{st} excited state has
A) one antinode B) two antinodes C) one node D) None of these

b. What is an eigen function and write the conditions to be satisfied by an eigen function. **(05 Marks)**

c. Set up one – dimensional time independent Schrodinger wave equation. **(07 Marks)**

d. A particle is confined to an one dimensional infinite potential well of width 0.2nm. It is found that the energy of the particle is 0.046ev when it is in II excited state. Find the mass of the particle. **(04 Marks)**

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

i) As per Classical free electron theory, the average kinetic energy of a free electron in the absence of an external field is
A) $\frac{2}{3}$ KT B) $\frac{1}{3}$ KT C) $\frac{3}{2}$ KT D) $\frac{3}{2}$ R

ii) Classical free electron theory fails to explain
A) Ohm's law B) Resistivity of a metal
C) Relation between resistivity and temperature of the metal
D) Current in a conductor

iii) The mobility of a free electron in a metal is
A) Directly proportional to applied field B) Independent of applied field
C) Inversely proportional to applied field D) None of these

iv) Quantum free electron theory is based on
A) Heisenberg uncertainty principle B) Pauli's exclusion principle
C) Maxwell – Boltzmann statistics D) Debroglic hypothesis

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

c. Explain Fermi probability factor. Calculate the Fermi factor f(E) for cases
i) $E < E_F$ at T = 0 K ii) $E > E_F$ at T = 0K iii) $E = E_F$ at $T \neq 0$. **(06 Marks)**

d. Find the temperature at which there is 1 percent probability that a state with an energy 0.5 eV above fermi energy will be occupied by an electron. **(04 Marks)**

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

i) Which of the following polarization mechanism is temperature sensitive
A) Electronic B) Ionic C) Orientation D) None of these

ii) Orientation polarization is observed in
A) Mica B) Paper C) Water D) Rubber

iii) Which of the following polarizations will disappear in a dielectric when the alternating field frequency exceeds infrared frequency
A) Electronic B) Ionic C) Orientation D) Space charge

iv) Which of the following material is Ferro electric
A) Sodium chloride B) Cellulose
C) Sodium dihydrogen phosphate D) Sodium bi carbonate

b. Derive Claussius – Mosotti equation. **(05 Marks)**

c. Explain properties of Ferro electric materials. **(06 Marks)**

d. Find the Polarisability of carbon dioxide , if its dielectric susceptibility is 0.985×10^{-3}. Density of CO_2 is 1.977 kg/m^3 , Molecular Wt. of CO_2 is 44. **(05 Marks)**

PART - B

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

i) Life time of excited electrons in a meta stable state is of the order of
A) 10^{-8} sec B) 10^{-6} sec C) 10^{-3} sec D) 10^{-9} sec

ii) Under equilibrium conditions, which process is dominant
A) Induced absorption B) Spontaneous emission
C) Stimulated emission D) Both A and B

iii) In holography which of the following laser property is applicable
A) Directionality B) Mino chromaticity C) Coherence D) Intensity
iv) Which of the following lasers is used for laser welding
A) Ruby laser B) Semi conductor laser
C) He – Ne laser D) Carbon dioxide laser

b. Derive an expression for energy density of the radiation field using Einstein's coefficients. **(08 Marks)**

c. Discuss the four characteristic propertie of laser. **(04 Marks)**

d. Write a note on Laser welding. **(04 Marks)**

6 a. Choose the correct answers for the following : **(04 Marks)**
i) Superconducting magnets are made of
A) Type – I super conductors B) Type – II super conductors
C) Both Type – I and Type – II Super conductors
D) None of these
ii) Critical magnetic field of a super conductor at its critical temperature is
A) One unit B) Zero C) Infinity D) None of these
iii) Signal distortion is minimumin
A) Singal mode step index fiber B) Multi mode step index fiber
C) Graded index fiber D) Both A & B
iv) Attenuation in a fiber is due to
A) Diffraction B) Refraction C) Rayleigh scattering D) Interference

b. Discuss the effect of magnetic field on super conductivity. **(06 Marks)**

c. Explain the propagation of signal's in different type of fibers with their refractive index profile. **(06 Marks)**

d. The critical magnetic field for Niobium is 1×10^5 A/m at 8K and 2×10^5A/m at 0 K. Calculate its critical temperature. **(04 Marks)**

7 a. Choose the correct answers for the following : **(04 Marks)**
i) The most asymmetric crystal system is
A) Cubic B) Monoclinic C) Hexagonal D) Triclinic
ii) Empty space is maximum in ?
A) Simple cubic B) Body centered cubic
C) Face centered cubic D) Body centered tetragonal
iii) The number of atoms/unit cell in a diamond lattice is
A) 2 B) 4 C) 6 D) 8
iv) The angle between crystallographic axes in a trigonal lattice is
A) $\alpha = \beta = \gamma = 90^0$ B) $\alpha = \gamma = 90^0 \neq \beta$ C) $\alpha \neq \beta \neq \gamma$ D) $\alpha = \beta = \gamma \neq 90^0$

b. Discuss the crystal structure of sodium chloride with a neat diagram of its unit cell. **(06 Marks)**

c. Explain how crystal structure of a cubic lattice can be determined using Bragg's spectrometer. **(06 Marks)**

d. Copper has FCC structure and the atomic radius is 0.127nm. Calculate its density AT. Wt. of copper is 63.5. **(04 Marks)**

8 a. Choose the correct answers for the following : **(04 Marks)**
i) Ultrasonic waves can be generated by
A) Inverse Piezo electric effect B) Piezo electric effect
C) Electro magnetic induction D) None of these

ii) Diffraction of ultrasonic waves is negligible because they have
A) High velocity B) High intensity
C) Very short wavelength D) None of these

iii) Quantum dots are
A) One dimensional nano material B) Two dimensional nano materials
C) Three dimensional nano materials D) None of these

iv) When ultrasonic waves travel in a liquid they produce
A) Cavitation B) Condensation and Rarefaction
C) Beats D) Both A & B

b. Describe non – destructive testing of materials by Pulse – echo method. **(06 Marks)**

c. Describe an experiment to determine the velocity of ultrasonic wave in a liquid by the principle of aqua grating. **(06 Marks)**

d. In an Acoustic grating experiment, it is found that angular separation of spectral lines in first order spectrum is 6′ when an ultrasonic wave of frequency 2 MHz is propagating in the given liquid. Given the wavelength of monochromatic radiation $\lambda = 6390\,\overset{0}{A}$. Calculate the velocity of ultrasonic waves in the given liquid. **(04 Marks)**

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