

- (d) For a given dielectric, as the temperature increases, the ionic polarizability :
- Increases
 - Decreases
 - First increases then decreases
 - Remain unchanged.
- (e) Above curie temperature, the hysteresis loop of a ferroelectric material merges into :
- Parabola
 - Straight line
 - Ellipse
 - Point.
- (f) Magnetic field can be produced due to :
- Moving charge
 - Time varying of electric field
 - Current
 - All the above
- (g) The energy per unit time, per unit area transported by the electromagnetic fields is expressed as :
- $\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$
 - $\vec{S} = \mu_0(\vec{E} \times \vec{B})$
 - $\vec{S} = (\vec{E} \times \vec{B})$
 - $\vec{S} = \epsilon_0(\vec{E} \times \vec{B})$
- (h) The property of the material which dose not show an appreciable change in superconducting state as compared to normal state is :
- Entropy
 - Thermal conductivity
 - Volume
 - Specific heat
- (i) The energy band gap of a superconductor is highest at :
- 0 K
 - Transition temperature
 - Room temperature
 - None of the above

- (j) Armchair, zig-zag and chiral are the classifications of :
- (i) Buckyballs
 - (ii) Multiwalled nanotubes
 - (iii) Doublewalled nanotubes
 - (iv) Singlewalled nanotubes

SECTION—B

2. Attempt any **three** parts of the following : (3×5=15)
- (a) Calculate the wavelength of an electron that has been accelerated in a particle accelerator through a potential difference of 100 volt.
 - (b) A beam of gamma radiation having photon energy 510 keV is incident on an aluminium foil. Calculate the wavelength of scattered radiation at 90°.
 - (c) If a *NaCl* crystal is subjected to an electric field of 1500 V/m and the resulting polarization is $4.3 \times 10^{-8} \text{ C/m}^2$, calculate the relative permittivity of *NaCl*.
 - (d) If the upper atmospheric layer of earth receives 1360 W m^{-2} energy from the sun, what will be the peak values of electric and magnetic fields at the layer ?
 - (e) A superconducting Lead has a critical temperature of 6.2 K at zero magnetic fields and a critical field of 0.0306 Tesla at 0 K. Determine the critical field at 3.1 K.

SECTION—C

Note : Attempt **all** questions of this Section. All questions carry equal marks.

3. Attempt any **one** part of the following : (1×5=5)
- (a) Derive the de-Broglie wavelength of a particle as function of temperature.

(b) What is Heisenberg's uncertainty principle ? Give its physical significance.

4. Attempt any **one** part of the following : (1×5=5)

(a) Derive time independent Schrödinger wave equation for a particle. What happens if the particle is free ?

(b) What do you mean by Compton shift ? Explain that shift is not observable with visible light.

5. Attempt any **one** part of the following : (1×5=5)

(a) Explain briefly the different types of polarization in dielectrics.

(b) What is hysteresis curve ? Show that the area of this curve is equal to the hysteresis loss in each cycle.

6. Attempt any **one** part of the following : (1×5=5)

(a) Explain the concept of displacement current. How it makes the Ampere's law to valid for non steady state ?

(b) Write down the Maxwell equations in conducting medium and use these equations to derive wave equations.

7. Attempt any **one** part of the following : (1×5=5)

(a) What are superconductors ? Explain their classification as type I and type II superconductors.

(b) What are carbon nanotubes ? Explain the CVD technique for its synthesization.

Physical constants :

Speed of light $c = 3.0 \times 10^8$ m/s

Plank's constant $h = 6.62 \times 10^{-34}$ J-s

Mass of electron $m = 9.1 \times 10^{-31}$ Kg

Permeability $\mu_0 = 4\pi \times 10^{-7}$ H/m

Permittivity $\epsilon_0 = 8.854 \times 10^{-12}$ F/M