Q. P. Code: 26571

Time: 2 hours   **Marks: 60**

N. B.   1) Question no **1** is **compulsory**.
2) Attempt any **three** questions from **Q.2 to Q.6**
3) Assume suitable data wherever required.
4) Figures on the **right** indicates **marks**.

1   Attempt **any five**   15
a   Why X-rays are used to study the crystal structure?
b   Calculate the frequency and wavelength of photon whose energy is 75eV.
c   Draw the energy band diagram of p-n junction diode in forward and reverse bias condition.
d   "Superconductor is a perfect diamagnetic", Explain.
e   What is reverberation time? How is it important? Write the factor affecting reverberation time.
f   A quartz crystal of thickness 1.5mm vibrating with resonance. Calculate it's fundamental frequency if the Young's modulus of quartz crystal is $7.9 \times 10^{10} N/m^2$. and density is $2650 kg/m^3$.
g   Mobility's of electron and hole in a sample of Ge at room temperature are $0.36 \ m^2/V$-sec and $0.17 m^2/V$-sec. respectively. If electron and hole densities are equal and it is $2.5 \times 10^{13}/cm^3$, calculate its conductivity.

2   a   Arrive at Heisenberg's uncertainty principle with single slit electron diffraction.   4
An electron has a speed of 300m/sec. with uncertainty of 0.01%. Find the accuracy in its position.   4
b   Write the Fermi Dirac distribution function and terms in it.   7
What is the probability of an electron being thermally excited to the conduction band in Si at $30^0 C$. The band gap energy is 1.12eV.

3   a   With neat diagram of unit cell, explain the structure of NaCl crystal and calculate the no of ions per unit cell, coordination no. and lattice constant. Calculate the packing factor of NaCl crystal assuming the radius of Na^+ is $0.98A^0$ and radius of Cl^- is $1.81A^0$.   8
b   State the Hall effect. Derive the expression for Hall voltage and Hall coefficient with neat diagram.   7

4   a   What is working principle of SQUID? Explain how it is used to detect the magnetic field?   5
b   A hall of dimensions $25x18x12m^3$ has an average absorption coefficient 0.2. Find the reverberation time. If a curtain cloth of area $150m^2$ is suspended at the Centre of hall with coefficient of absorption 0.75, What will be the reverberation time?   5
c   State the piezoelectric effect. With neat circuit diagram explain the principle and working of piezoectric oscillator.   5

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5   a   With energy band diagram, explain the variation of Fermi energy level with impurity concentration in extrinsic semiconductor.   5

     b   Explain with example how to determine crystal structure by Bragg's X-ray spectrometer.   5

     c   Obtain one dimensional time independent Schrodinger equation.   5

6   a   Define ligancy and critical radius ratio. Calculate critical radius ratio for ligancy 8.   5

     b   What is the significance of wave function? Derive the expression for energy eigen values for free particle in one dimensional potential well.   5

     c   What is photovoltaic effect? Explain the principle and working of Solar cell.   5

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