Time: 3 Hrs.   **Max Marks: 100**

Note: *Answer any FIVE full Questions choosing TWO Questions from PART-A,*
TWO Questions from PART-B and ONE Question from PART-C.

Physical constants: Electron mass, $m = 9.11 \times 10^{-31}$ Kg, Electron charge, $e = 1.602 \times 10^{-19}$ C, Velocity of light, $c = 3 \times 10^8$ ms^{-1}, Planck's constant, $h = 6.625 \times 10^{-34}$ Js, Boltzmann constant, $K = 1.38 \times 10^{-23}$ JK^{-1}, Avagardo number, $N = 6.025 \times 10^{26}$/K mole, Permitivity of vacuum, $\epsilon_0 = 8.85 \times 10^{-12}$ Fm^{-1}

Note: Answer any FIVE full questions by choosing at least TWO questions from each part

PART-A

1 **a)** What is black body? Discuss in briefly Wein's and Rayleigh-Jean's law to explain blackbody radiation.   **8**

   b) Explain Planck's quantum hypothesis. Derive Planck's law of radiation.   **8**

   c) State and explain Stefan-Boltzmann law.   **4**

2 **a)** Discuss the effect of temperature and impurity on electrical resistivity of metals.   **5**

   b) Define density of states. Derive an expression for the density of states for conduction electrons per unit volume of metal.   **10**

   c) Show that the occupation probability at $E = E_F + \Delta E$ is equal to the non-occupation probability at $E = E_F - \Delta E$ **5**

3 **a)** Explain i) Bravais lattice   ii) Lattice parameters. Distinguish between unit cell and primitive cell.   **6**

   b) Explain the origin of continuous X-ray spectrum.   **5**

   c) Derive Bragg's law of X-ray diffraction**.**
   First order Bragg's reflection occurs when a monochromatic beam of X-ray of wavelength 0.675Å is incident on a crystal at a glancing angle of 4.85˚. What is the glancing angle for third order Bragg's reflection to occur?   **9**

4 **a)** What are matter waves**?** Describe the Davison and Germer experiment to determine the wave nature of electrons.   **10**

   b) Write a note on eigen values and eigen functions.   **6**

   c) Calculate the deBroglie wavelength associated with an electron with a kinetic energy of 2000eV.   **4**

PART-B

5 **a)** What are the postulates of special theory of relativistic? Derive an expression for relativity variation of mass with velocity.   **7**

   b) Derive the Einstein's energy mass relation and obtain the expression for energy and momentum of the particle.   **8**

   the total energy of a particle is exactly thrice its rest energy, what is the velocity of article?   **5**

6	a)	Describe the different types of dielectric polarization.	6
	b)	What are dielectrics? Derive an expression for internal field in the case of dielectric solids.	9
	c)	The dielectric constant of sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of sulphur. Given for sulphur density $= 2.07 \times 10^3$ Kg/m^3 and atomic weight $= 32.07$.	5

7	a)	Explain the phenomenon of superconductivity and Meissner effect.	6
	b)	Describe Type-I and Type-II superconductors.	7
	c)	Write a note on i)High temperature superconductors and ii) Maglev vehicle.	7

8	a)	Write a note on carbon nanotubes.	5
	b)	Describe the principle and method used in the 'Non-Destructive Testing of materials' for defects using ultrasonics.	7
	c)	The velocity of longitudinal and transverse ultrasonic waves in a metal of density 2.71gm/cc is 6.42km/s and 3.04km/s respectively. Calculate the Poison's ratio, Young's modulus and rigidity modulus of the metal.	6

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