(First Semester)

Branch - **PHYSICS**

SOLID STATE PHYSICS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Electronic specific heat of metals at low temperature varies as a) T b) T^2 c) T^3 d) Constant	K1	CO2
	2	The resistivity of metals at absolute zero temperature is a) Zero b) Infinite c) Same as at room temperature d) Negative	K2	CO1
2	3	The law that states the specific heat of solids tends to 3R at high temperature is a) Debye law b) Dulong-petit law c) Einstein law d) Bloch law	K1	CO2
	4	The first Brillouin zone in one dimension is defined by k values between a) 0 $and\ \pi/a$ b) $-\pi/a\ and\ \pi/a$ c) $-2\pi/a\ and\ 2\pi/a$ d) $\pi/a\ and\ 2\pi/a$	K2	CO1
3	5	Polarizability is defined as a) Ratio of dipole moment to applied electric field b) Ratio of charge to mass c) Ratio of current to voltage d) Ratio of dielectric constant to polarization	K1	CO3
	6	Dielectric which show spontaneous polarization are called a) Pyroelectric b) Piezoelectric c) Ferroelectric d) Centrosymmetric	K2	CO3
4	7	The principal quantum number (n) indicates a) Shape of orbital b) Size and energy of orbital c) Orientation of orbital d) Spin of electron	K1	CO4
	8	The general chemical formula for many ferrites is a) MO b)MFe_2O_4 c)Fe_2O_3 d)MgO	K2	CO4
5	9	The Meissner effect causes the superconductor to behave like a a) Perfect conductor b) Perfect diamagnet c) Ferromagnet d) Paramagnet	K1	CO5
	10	The critical temperature of high temperature superconductors is usually above a) 4 K b) 20 K c) 77 K d) 200 K	K2	CO5

Cont...

Answer ALL questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Illustrate how degeneracy arises in quantum systems with suitable examples.	K2	CO1
		(OR)		
	11.b.	Describe how Ohm's law and the Wiedemann-Franx-Lorenx law help in studying the electrical conductivity of materials.		
2	12.a.	Analyze how both electrons and phonons contribute to the thermal conductivity of metals and semiconductors.	K3	CO2
		(OR)		
	12.b.	Construct and explain the first Brillouin zone for a two-dimensional square lattice.		
3	13.a.	Illustrate the mechanism of ferroelectricity in crystals and explain how dielectric constant varies with temperature.	K4	CO3
		(OR)		
	13.b.	Explain the classical theory of electronic polarizability to derive an expression for polarizability of atom in terms of its electron charge and mass.		
4	14.a.	Compare the different types of magnetic materials and explain their behavior in an external magnetic field.	K5	CO4
		(OR)		
	14.b.	Explain the relationship between domain structure and macroscopic magnetization in ferromagnetic materials.		
5	15.a.	Explain the origin and significance of the energy gap in BCS theory, and how the isotope effect supports the phonon-mediated pairing mechanism.	K5	CO5
		(OR)		
	15.b.	Explain London penetration depth and coherence length.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Derive and explain the expression for the density of states as a function of electron energy in three-dimension and analyze how it depends on the electron energy.	K3	CO1
2	17	Analyze the Kroning-Penny model and explain how it leads to the concept of allowed and forbidden energy bands also discuss its limitations.	K4	CO2
3	18	a) Describe the method used to measure the dielectric constant of a material. b) Discuss the different types of polarizability in dielectric materials and evaluate their contributions to the total polarizability.	K2	CO3
4	19	Critically analyze the domain theory of ferromagnetism by explaining the role of four types of energy in determining domain formation and stability.	K5	CO4
5	20	Describe the phenomenon of normal tunneling in superconductors, Additionally discuss the Josephson effect, and derive the expression for the Josephson current	K5	CO5

Z-Z-Z END