BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO2022)

CLASS: IMSC **SEMESTER : V**
BRANCH: PHYSICS **SESSION : MO /2022**

SUBJECT: PH302 SOLID STATE PHYSICS

TIME: 03 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

Q.1(a)	Define primitive and nonprimitive translational vectors.	[2]	(C01, BL1)
Q.1(b)	State the scheme to determine the Miller indices of a plane. Find the Miller indices of the plane having the intercepts 5a, -6b and c along the three crystallographic directions.	[3]	(C01, BL3)
Q.1(c)	What are Brillouin zones? Determine the reciprocal lattice vectors which define the Brillouin zone of a fcc lattice.	[5]	(C01, BL5)
Q.2(a)	What is Debye T^3 law?	[2]	(C02, BL1)
Q.2(b)	Draw the phonon dispersion curve for a diatomic lattice. Differentiate between optical and acoustical modes of wave propagation for a linear diatomic crystal.	[3]	(C02, BL2)
Q.2(c)	How does the Debye model differ from the Einstein model of lattice heat capacity? Evaluate the specific heat of silver at 20 K taking the characteristic temperature to be 210 K according to (i) Einstein's theory (ii) Debye's theory.	[5]	(C02, BL5)
Q.3(a)	Define the Curie law of paramagnetism.	[2]	(C03, BL1)
Q.3(b)	What is diamagnetism? Why diamagnetic materials have negative susceptibility?	[3]	(C03, BL1)
Q.3(c)	Describe the Langevin's theory of paramagnetism and obtain an expression for paramagnetic susceptibility.	[5]	(C03, BL5)
Q.4(a)	What is Bloch Theorem?	[2]	(C04, BL1)
Q.4(b)	Distinguish between a metal, a semiconductor and an insulator on the basis of their energy band structure.	[3]	(C04, BL4)
Q.4(c)	Prove that the motion of electrons through the periodic potential in solids gives rise to the band structure.	[5]	(C04, BL5)
Q.5(a)	What is a Cooper pair?	[2]	(C05, BL1)
Q.5(b)	What is Meissner effect? Differentiate between type I and type II superconductors using the Meissner effect.	[3]	(C05, BL4)
Q.5(c)	Develop London's 1^{st} and 2^{nd} equation for a superconducting sample in a magnetic flux B. Explain how it leads to the concept of penetration depth in a superconductor.	[5]	(C05, BL6)

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