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

CLASS: IMSC **SEMESTER : V**
BRANCH: PHYSICS **SESSION : MO/2025**

SUBJECT: PH302R1: SOLID STATE PHYSICS

TIME: 3 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*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

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Q.1(a)	Determine the ratios of the interplanar spacings $d_{100}: d_{110}: d_{111}$ for both simple cubic (SC) and body-centered cubic (BCC) crystal lattices.	[5]	01	03
Q.1(b)	Derive Bragg's law. The Bragg angle for the (220) reflection from nickel (FCC) is $38.2°$ when X-rays of wavelength 1.54 Å are used in a diffraction experiment. Calculate the lattice parameter of nickel	[5]	01	04
Q.2(a)	Derive the dispersion relation for lattice vibrations in a one-dimensional monoatomic linear chain.	[5]	02	04
Q.2(b)	State Bloch's theorem and derive the form of the electron wavefunction in a periodic potential. What is its significance in solid-state physics?	[5]	02	02
Q.3(a)	Describe Weiss's molecular field theory of ferromagnetism. How does it explain spontaneous magnetization?	[5]	03	02
Q.3(b)	Discuss the B–H curve for a ferromagnetic material. Explain the meaning of key points such as saturation, retentivity, and coercivity.	[5]	03	02
Q.4(a)	Define electric susceptibility and polarizability. Derive the relation between them.	[5]	04	04
Q.4(b)	Explain the piezoelectric effect. Distinguish between the direct and inverse piezoelectric effects and discuss their applications.	[5]	04	02
Q.5(a)	Describe the Meissner effect. How does it distinguish a perfect conductor from a superconductor?	[5]	05	02
Q.5(b)	State London's equations. Explain how they lead to the phenomenon of magnetic field penetration depth in superconductors.	[5]	05	04

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