

5. (a) Derive an expression for dispersion relation for the vibrational modes of diatomic linear lattice having masses m and M . ($M > m$). (9)
- (b) Show that only one of the mass vibrates at zone boundary in each branch. (4)
- (c) Differentiate between 'soft and hard materials' on the basis of B-H curve. (5)
6. (a) What is free electron theory of metals (Drude model). What are its successes and drawbacks? (6)
- (b) Find the expression for the Hall coefficient of a semiconductor in which both electrons and holes are present in equal concentrations. How will this expression change if the holes concentration is twice the electron concentration and vice-versa? (8)
- (c) Explain how will this expression be modified if the semiconductor is heavily doped with p-type impurity or n-type impurity? (4)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3403

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Unique Paper Code : 2224002002

Name of the Paper : Solid State Physics (GE paper)

Name of the Course : **B.Sc. Hons.-(Physics)_NEP: UGCF-2022**

Semester : III / V

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Answer **five** questions in all.
3. Question No. 1 is compulsory.
4. **All** questions carry equal marks.

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1. Attempt any **six** parts. (3×6=18)
- (a) What are the failures of Rutherford's atomic model?
 - (b) What is a point defect in crystals?
 - (c) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials on the basis of magnetic susceptibility.
 - (d) Discuss how the linear mono-atomic chain of atoms behaves as a low pass filter?
 - (e) How does a superconductor differ from a perfect conductor?
 - (f) Discuss briefly the various sources of polarizability.
 - (g) Distinguish between direct and indirect band gap with the help of diagram. Give one example of each.
2. (a) Write six differences between Amorphous and Crystalline material? (6)
- (b) Calculate the numerical value of Atomic Packing Factor of a hexagonal closed packed structure. (6)

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- (c) A first order reflection from (111) plane is observed for LiX with $2\theta = 24.6^\circ$ (X-ray of wavelength $1.54 \text{ \AA}$). Assuming LiX to be a cubic crystal system, calculate the length of the side of the unit cell in angstrom. [Given $\sin(12.3^\circ) = 0.123$] (6)
3. (a) Find the Reciprocal Lattice vectors for $a = a/2(i+j-k)$, $b = a/2(-i+j+k)$ and $c = a/2(i-j+k)$. Also identify the structure represented by the reciprocal lattice vectors so obtained. (6)
- (b) Define Brillouin zones. Draw first two Brillouin zones of a square lattice. (8)
- (c) In a triclinic crystal, a plane makes intercepts at a length 'a', '2b' and '-3c/2'. Find the miller indices of the plane. (4)
4. (a) What is meant by local field in a dielectric? Obtain an expression for the local field for an atom in a dielectric medium. (8)
- (b) Discuss piezoelectric and pyroelectric effects with examples. (4)
- (c) Describe the significance of critical temperature and critical magnetic field for superconductors. (6)

P.T.O.