



11-12-17

DOON UNIVERSITY, DEHRADUN
End Semester Examination, Second Semester, 2017-18
School of Physical Sciences
5-year M Sc Integrated Physics (Core Course)
Course: PHC-302: Solid State Physics

Time Allowed: 3Hours

Maximum Marks: 30

Note: Attempt All Questions from Sections A, B, C.

SECTION: A

(Marks: 1X6=6)

1. Give an example of a crystal that is piezoelectric but not ferroelectric?
2. Which type of polarisation is most effective in the IR region?
3. Pure Si at 0K is _____. (1/2)
4. The phenomenon of expelling magnetic flux by a superconductor is known as _____
5. What do you understand by Bloch theorem?
6. The polarization P in a solid dielectric is related to the electric field E and displacement vector D by the relation _____
7. There is a (011) plane in a unit cell of Si (Si). Indicate the positions of all atoms lying in the plane. Represent atoms as 2-dimensional slices of space-filling spheres.
8. The temperature at or above which an antiferromagnetic substance becomes paramagnetic is called _____. (1/2)

SECTION: B

(Marks 4X3=12)

9. (a) In a simple cubic structure of lattice constant a, one plane among z set of parallel planes intercepts x, y and z-axis 2a, a and a respectively. Calculate the interplanar spacing.
(b) Determine the dispersion relation of phonons in a one-dimensional crystal with one atom per primitive cell. Also plot the relation.
10. (a) What are hard superconductors? Explain the concept of critical field in hard superconductors? Give an example of soft superconductor.
(b) The transition temperature of mercury with an average atomic mass of 200.59 amu is 4.153 K. Determine the transition temperature of one of its isotopes, $^{204}_{80}\text{Hg}$
11. (a) Differentiate between ferrimagnetism and antiferromagnetism with examples?
(b) Explain the quantum theory of paramagnetism?

SECTION: C

(Marks: 6X2=12)

12. (a) Derive a relationship between dielectric constant and atomic polarizability? Name the expression.
(b) What are ferroelectric domains? Explain the curve between polarization and electric fields?
OR
(c) Explain the meaning of piezoelectricity. Justify the statement "All ferroelectric crystals are piezoelectric, but all piezoelectric crystals are not necessarily ferroelectric."
13. Starting from the Schrodinger equation for a periodic 1D system, show that the energy states deviate substantially as the electron approaches the Brillouin zone boundary. Draw the corresponding E-k diagram and compare it with that in the free electron case.