

2019

B.Sc.

3rd Semester Examination

PHYSICS (Honours)

Paper - GE 3-T

Full Marks : 40

Time : 2 Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.*

Group - A

1. Answer any five questions of the following :

5×2=10

- (a) Draw the plane of Miller indices (101).
- (b) Discuss Bragg's law of X-ray diffraction.
- (c) Draw the E-K diagram of a free electron and a bound electron.
- (d) For Al, Debye temperature is 4280K, and speed of sound is 5×10^3 m/s. Find the wavelength of lattice vibration at Debye temperature.

[Turn Over]

- (e) Calculate the diamagnetic susceptibility of atomic hydrogen in the ground state at S. T. P using the ground state wave function

$$\psi(r) = \left(\frac{1}{\pi a_0^3} \right)^{1/2} e^{-r/a_0}$$

- (f) The transition temperature of Mercury with an average atomic mass of 200.59 is 4.153k. Determine the transition temperature of its isotope of mass 204.
- (g) What is phonon ?
- (h) Define geometrical structure Factor.

Group - B

2. Answer any *four* questions :

4×5

- (a) Find an expression for the interplaner spacing (d_{hkl}) for (hkl) planes of a simple cubic lattice.
- (b) Find the expression for the susceptibility of diamagnetic substance.
- (c) Deduce Einstein's Theory of specific heat of solids. What are its draw back ?
- (d) What is dipolar polarization ? Find the expression for dipolar polarizability.

- (e) What is Meissner Effect ? Discuss type-I and type-II super conductor with examples of each.
- (f) Draw the variation of Energy, velocity and effective mass of an e^- in a solid as a function of K . Explain the concept of Energy band.

Group - C

3. Answer any *one* question : 1×10

- (a) Find the reciprocal lattice of a simple cubic lattice. 3
- (b) What are hard and soft magnetic materials — draw their B-H loop. 2+2
- (c) Using the Kronig-Penney model, show that for $p \ll 1$ the energy of the lowest band is

$$E = \frac{\hbar^2 p^2}{ma^2}. \quad 3$$

4. (a) Deduce Laue's equation for X-ray diffraction for solid. Hence establish Bragg's law. 5+2
- (b) Write down the dispersion relation for a monoatomic chain of molecules. Find the phase and group velocity of phonon at the 1st Brillouin zone. 3