D 6725 (Pages : 2) Name.....

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2016

(CUCSS)

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2012 Admissions)

Time : Three Hours Maximum : 36 Weightage

Part A

Answer **all** *questions.*
Each question carries 1 *weightage.*

1. What are Brillouin Zones ?
2. Explain covalent bonding.
3. What are imperfections in crystals ?
4. Explain the term effective mass.
5. What is a direct gap material ? Give an example.
6. What are phonon modes ?
7. Explain the origin of diamagnetism.
8. What are ferrites ?
9. Explain the term polarization catastrophe.
10. Show how thermal conductivity changes with temperature.
11. What is isotope effect in superconductivity ?
12. Explain the term single particle tunnelling.

(12 × 1 = 12 weightage)

Part B

Answer any **two** *questions.*
Each question carries 6 *weightage.*

1. Explain the various methods in X-ray diffraction used to elucidate the structure of crystals.
2. Discuss Langevin's theory of paramagnetism. Explain Hund's rule.

Turn over

3. Obtain an expression for carrier concentration in conduction band for a semiconductor.
4. Explain flux quantization. Describe Josephson effect and give a brief account of SQUIDS.

(2 × 6 = 12 weightage)

Part C

Answer any **four** *questions.*
Each question carries 3 *weightage.*

1. Show that the reciprocal lattice for a BCC lattice is FCC lattice.
2. A lattice is characterised by the primitive vectors $\vec{a}=2\left(\hat{i}+\hat{j}\right);\vec{b}=2\left(\hat{j}+\hat{k}\right)$ and $\vec{c}=2\left(\hat{k}+\hat{i}\right)$. Find the reciprocal lattice to the original one and the cubic edge.
3. Two branches of a phonon spectrum of a cubic lattice is $\omega_1\left(\hat{k}\right)=A|\sin k|$ and $\omega_2\left(\hat{k}\right)=\mathrm{B}(2+\cos k)$. In the Debye approximation find the phonon dispersion relations for each branch.
4. Find the Fermi velocity of electrons in Potassium if its Fermi energy is 2.1 eV.
5. Calculate the frequency of the AC current produced when a DC voltage of 5 μV is applied across the Josephson junction.
6. A paramagnetic material with spin magnetic dipole moment is placed in a magnetic field of 10^5 A/m. Evaluate the average magnetic moment per dipole at 300 K.

(4 × 3 = 12 weightage)