



UNIVERSITY OF THE PUNJAB

Seventh Semester – 2019

Examination: B.S. 4 Years Program

Roll No. in Fig.

Roll No. in Words.

PAPER: Solid State Physics-I
Course Code: PHY-419 Part-I (Compulsory)

MAX. TIME: 15 Min.

MAX. MARKS: 10

Signature of Supdt.:

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Division of marks is given in front of each question.

This Paper will be collected back after expiry of time limit mentioned above.

Q.1: Encircle the right answer, cutting and overwriting is not allowed. (1x10=10)

1. In the free electron model of solids
 - A. Energy bands are formed at the zone boundary
 - B. Metals can be differentiated from insulators
 - C. Superconductivity phenomenon can be explained
 - D. No concept of energy bands is evolved
2. The Linear Combination of Atomic orbital (LCAO) method for band calculation of solid is suitable for
 - A. Metals
 - B. Semiconductor/insulator
 - C. Poly crystalline solid
 - D. Amorphous solid
3. Which is not true for electrons in a periodic boundary condition
 - A. Continuous k states
 - B. Discrete k states or quasi-continuous
 - C. There are finite k states possible
 - D. The P.E of free electron is zero
4. When sample of a solid is subjected to electric field, the free electrons in solid
 - A. Gain velocity increment greater than their thermal velocity
 - B. The net momentum acquired by the free electrons is zero
 - C. The drift velocity of free electron is of the order of 1-10 cm/s
 - D. Have mean free path equal to the length of the conductor
5. The ratio of thermal conductivity to electrical conductivity (Weidmann -Franz law) depends on
 - A. Density of electrons
 - B. Mass of electrons
 - C. Relaxation time
 - D. None of the above
6. In the x-ray diffraction from crystalline solid, the diffraction pattern
 - A. Replicates exactly the real atomic position of the solid
 - B. Is a map of the reciprocal lattice of the crystal
 - C. Shows the position of electrons in solid
 - D. Gives the surface morphology of the crystal

P.T.O.

7. In the free electron model of solid
 - A. The wave function associated with free electrons converges at the cell boundary
 - B. The electron-electron interaction is taken into account
 - C. The electron-ion interaction is taken into account
 - D. The wave function associated with free electron is the free running plane wave which is unaffected by the lattice potential
8. The Augmented Plane Wave (APW) method for band calculation of solid
 - A. Has successfully been used to calculate energy bands in metals and Fermi surfaces
 - B. The APW waves join smoothly with spherical waves so that no discontinuity occurs at the boundary of the cell
 - C. The size of the matrix element at a general point is small so that energy value problem becomes easier
 - D. The APW method supports the free electron model of solid
9. In the Nearly free electron model
 - A. Band gaps have been shown to occur at the zone boundary
 - B. No distinction is made from the free electron model of solids
 - C. The physical phenomenon such as superconductive can be explained
 - D. The interaction between free electrons and ions is neglected
10. In the Orthogonalized Plane Wave (OPW) method
 - A. The Eigen functions associated with valence electrons converge properly at the cell boundary.
 - B. Applicability is limited to III-V compounds or ionic crystal.
 - C. The Eigen function is the same for valence electrons and Core electrons
 - D. A distinct division is made between the ion core states and valence electron states.



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PAPER: Solid State Physics-I
Course Code: PHY-419 Part – II

MAX. TIME: 2 Hrs. 45 Min.
MAX. MARKS: 50

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

- Q.2. Write short answers to the following questions. [2x10=20]
- Why do we call free electrons in metal as forming a dense gas?
 - Of the two Fermi Spheres, one is bigger than the other. Why is it due to?
 - What is the effect of free electron approximation on the behavior of electrons in metals?
 - In Oppenheimer approximation, what are the considerations which led to find out an effective Hamiltonian?
 - How is the concept of Orthogonalized Plane Wave (OPW) evolved for band calculation of solid?
 - State any two physical phenomena which cannot be explained on the basis of free electron model.
 - Write the components of the Hamiltonian for free electrons in the Hartee approximation.
 - In the solid state problems, which properties does a solid exhibit during its interaction with electromagnetic radiation?
 - What factors make the electron lighter or heavier in solid as compared to its mass when it is free?
 - What is the form of wave function to be used in Augmented Plane Wave (APW) method and give its properties?
- Q.3. How do free electrons in metal contribute to heat conductivity? Derive an expression for the thermal conductivity coefficient of metal. [10]
- Q.4. How is the wave function for electron, in a periodic potential, constructed in the Tight Binding Approximation (LCAO)? Show that such wave function satisfies the Bloch condition and is normalized. [10]
- Q.5. Give a brief description of the pseudopotential method to construct wave function. [10]