18PYB103J-Semiconductor Physics

Question Bank

Short Answer Type Questions

1. Write any two success and failures of classical free electron theory
2. Write any two success and failures of quantum free electron theory
3. Write a short note on Band theory of solids.
4. Explain E-K diagram with the help of Kronig-Penney Model (solution only)
5. Discuss Brillouin Zone for 1-D crystal lattice
6. Explain the concept of phonons in the indirect band gap materials using E-K diagram
7. Explain probability of occupation in a given energy level using Fermi-Dirac distribution
8. Write any two differences between n-type and p-type semiconductors
9. Explain direct band gap and indirect band gap in materials with the help of E-K diagram.
10. Write the classification of electronic materials on the basis of band theory

Descriptive Type Questions

1. (a) Explain classical free electron theory with success and failures
   (b) Explain quantum free electron theory with success and failures
2. (a) Derive the expression for effective mass of an electron
   (b) Write short notes non-equilibrium properties of carrier.
3. (a) Explain intrinsic semiconductor on the basis of energy levels.
   (b) Explain the influence of acceptors and donors in semiconductors with energy level diagrams
4. Define and derive the expression for density of states
5. Explain the motion of electron in periodic potential using Kronig-Penney Model

Multiple Choice Questions

1. What does conductivity of metals depend upon?
   a) The nature of the material
   b) Number of free electrons
   c) Resistance of the metal
   d) Number of electrons

2. What happens to the free electrons when electric field is applied?

a) They move randomly and collide with each other
b) They move in the direction of the field
c) They remain stable
d) They move in the direction opposite to that of the field

3. Outer most shell of atom with highest energy level is known as

a) 1st shell
b) 2nd shell
c) Valence shell
d) hole shell

4. Which of the following theories cannot be explained by classical theory?

a) Electron theory
b) Lorentz theory
c) Photo-electric effect
d) Classical free electron theory

5. Which of the following theories can be adopted to rectify the drawbacks of classical theory?

a) Compton theory
b) Quantum theory
c) Band theory
d) Electron theory

6. How does a semiconductor behave at absolute zero?

a) Conductor
b) Insulator
c) Semiconductor
d) Protection device

7. What are the charge carriers in semiconductors?

a) Electrons and holes
b) Electrons

c) Holes
d) Charges

8. How is charge carriers produced in intrinsic semiconductors?
a) By pure atoms
b) By electrons
c) By impure atoms
d) By holes

9. What type of material is obtained when intrinsic semiconductor is doped with pentavalent impurity?
a) N-type semiconductor
b) Extrinsic semiconductor
c) P-type semiconductor
d) Insulator

10. What type of material is obtained when an intrinsic semiconductor is doped with trivalent impurity?
a) Extrinsic semiconductor
b) Insulator
c) N-type semiconductor
d) P-type semiconductor

11. The motion of electron in periodic potential is explained by
a) Drude Model
b) Lorentz Model
c) Drude – Lorentz Model
d) Kronig Penny Model

12. According band theory of solids, the splitting up of energy levels start from
a) Outermost shell
b) First Shell
c) Second shell
d) Any Shell

13. According band theory of solids, the splitting up of energy levels will be maximum at
a) First Shell
b) Second shell

c) Any Shell

d) Outermost Shell

14. According to classical free electron theory,

1. there is no interaction between conduction electrons
2. the interaction of free electrons with ion cores is negligible
3. the free electrons find uniform electric field of positive ions and that of electrons in metal
4. all

15. Most commonly used semiconductor material is

a. Silicon

b. Germanium

c. Mixture of silicon and germanium

d. Arsenic.

16. Energy band gap size for insulators is in the range _____ eV.

a)1-2

b) 2-3

c) 3-4

d) > 4

17. Fermi energy level for intrinsic semiconductors lies

a) At middle of the band gap

b) Close to conduction band

c) Close to valence band

d) None

18. . In intrinsic semiconductors, number of electrons _____ number of holes.

a) Equal

b) Greater than

c) Less than

d) Can not define

19. Energy band gap size for insulators is in the range _____ eV.

a)1-2

b) 2-3

c) 3-4

d) > 4

20. A hole in the semiconductors treated as _____

a) A free electron

b) A incomplete part of electron pair bond

c) A free proton

d) A free neutron

21. The probability that an electron in a metal occupies the Fermi-level, at any temperature (>0 K) is

a) 0

b) 1

c) 0.5

d) none of the above

22. Consider the following statements: pure germanium and pure silicon are examples of:

1. Direct band-gap semiconductors
2. Indirect band-gap semiconductors
3. Degenerate semiconductors

Of these statements:

a) 1 alone is correct

b) 2 alone is correct

c) 3 alone is correct

d) none of the above

23. What is a Brillouin zone?

a) A region of energy---space that encompasses all of the unique values of energy
b) A region of position---space that the electron is allowed to reside within
c) Another name for the unit cell of the crystal
d) A region of k-space that contains all of the unique solutions of the wave equation
e) A region of k-space where the group velocity is positive

24. When temperature increases, intrinsic concentration increases which results in increase of

a) resistivity
b) conductivity
c) capacitivity
d) all of the above

25. Energy gap is overlapped between Valence band and conduction band in

a) insulators
b) conductors
c) semiconductors
d) super semiconductors