SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
RAMAPURAM

DEPARTMENT OF PHYSICS

PHYSICS: SEMICONDUCTOR PHYSICS (18PYB103J)

CHAPTER - 1

PART - A

1. Which of the following is responsible for electrical conduction in metal?
   a) Electrons
   b) Protons
   c) Neutrons
   d) Positrons

2. The electrons in inner shells are called as
   a) Valence electrons
   b) Core electrons
   c) Conductions electrons
   d) Free electrons

3. Conduction electrons in metal moves in _____
   a) Positive direction
   b) Negative direction
   c) Random direction
   d) Up and down

4. Free electrons move always in
   a) Positive direction
   b) Negative direction
   c) Random direction
   d) Up and down

5. The failures of classical theories were overcome by
   a) Sommerfeld
   b) Drude
   c) Widmann
   d) Lorentz

1) classical free e⁻ theory - Drude & Lorentz
2) Quantum free e⁻ theory - Sommerfeld
3) Zone theory - Bloch.

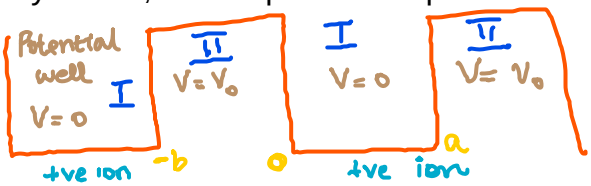
6. In Quantum theory electrons possess
   a) Particle nature
   b) Wave nature
   c) Liquid nature
   d) Gas nature

7. Free electrons in metals always obey
   a) Fermi Dirac statistics
   b) Wiedemann Franz law
   c) Bose Einstein Statistics → phonons
   d) Drude Lorentz theory

8. In real crystal at positive ion site, the potential of electrons will become
   a) Zero
   b) 1
   c) 2
   d) 3

Potential energy = 0
kinetic energy = Max

9. According to Kronig Penney model, the shape of inner potential of crystal is
   a) Rectangular
   b) Triangular
   c) Spherical
   d) Sinusoidal

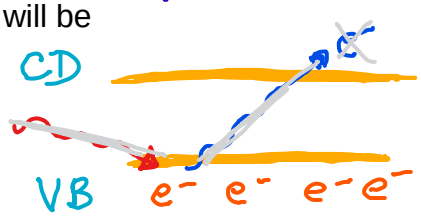


10. At low temperatures, semiconductors will become
    a) Conductors
    b) Insulators
    c) Ferroelectrics
    d) Superconductors

Because electrons will not have enough energy to jump from VB to CD

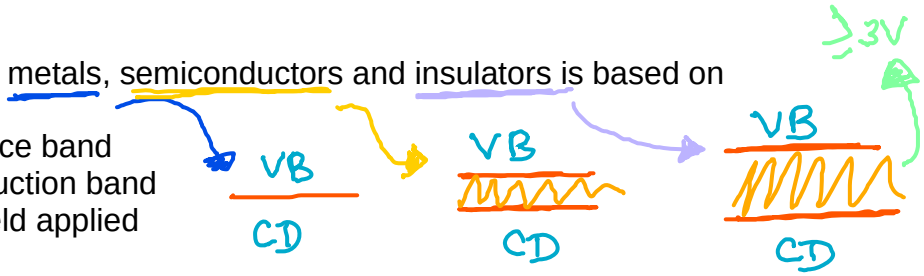
11. In semiconductors at low temperatures, the valence band will be
    a) Full
    b) Empty
    c) Partially full
    d) Partially empty

temperature ↓ heat



12. The conduction electrons always contribute to
    a) Electricity
    b) Conductivity
    c) Thermal effect
    d) Magnetic effect

13. The difference between metals, semiconductors and insulators is based on
    a) Value of bandgap
    b) No of electrons in valence band
    c) No of electrons in conduction band
    d) Magnitude of electric field applied



14. The free electron theory of metals was initiated by
    a) Pauli
    b) Sommerfeld
    c) Lorentz and Drude
    d) Fermi-Dirac

15. At any temperature T and for $E=E_F$ in metals, the Fermi-distribution function becomes
    a) 0
    b) Infinity
    c) 1
    d) ½

T = 0 $E < E_F$ 1

$E > E_F$ 0

T = Anything $E = E_F$ 0.5

Probability

16. The value of Fermi-distribution function at absolute zero (T = 0 K) is 1, i.e., F(E)=1, under the condition

a) $E > E_F$
b) $E < E_F$
c) $E = E_F$
d) $E >> E_F$

17. With the increase in temperature, the resistance of a metal

a) Remains constant
b) Increases
c) Decreases
d) Becomes zero

Energy of e^- are more than $\vec{E}$ has less effect, resistance → increases

18. A band or range of energy levels that an electron in a crystal is allowed to occupy is known as

a) Allowed energy bands
b) Energy bands
c) Forbidden energy bands
d) Energy Band-gap

19. A band or range of energy levels that an electron in a crystal is not allowed to occupy is known as

a) Allowed energy bands
b) Energy bands
c) Forbidden energy bands
d) Energy Band-gap

20. The principle stating that no two electrons can occupy the same quantum state is known as

a) Heisenberg Uncertainty principle
b) Pauli Exclusion principle
c) De Broglie principle
d) Quantum mechanical principle

21. The complex physical quantity which describes about the particle wave and helps deriving the probability density function is called as

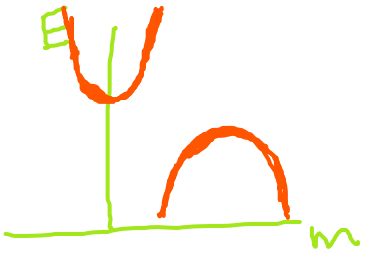
a) Wave equation
b) Wave function
c) Schroedinger equation
d) Probability density function

22. The first Brillouin zone is defined between the region

a) $k = 0$ to π/a
b) $k = -2\pi/a$ to π/a
c) $k = -\pi/a$ to $2\pi/a$
d) $k = -\pi/a$ to π/a

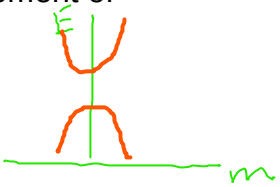
23. The indirect bandgap semiconductors require a change in energy along with change in

a) Momentum
b) Velocity

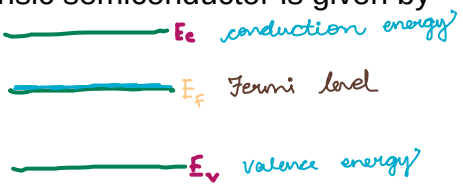


c) Mass
d) Potential

24. The direct bandgap semiconductors have the requirement of
a) Change in energy & change in momentum
b) No change in energy & change in momentum
c) No change in energy & no change in momentum
d) Change in energy & No change in momentum



25. The position of fermi level E_F in an intrinsic semiconductor is given by
a) $E_F = E_C - E_V$
b) $E_F = E_V - E_C$
c) $E_F = (E_V - E_C) / 2$
d) $E_F = (E_C + E_V) / 2$



26. The donor atoms in extrinsic n-type semiconductors contribute
a) Electrons to conduction band
b) Electrons to valence band
c) Holes to conduction band
d) Holes to valence band

n-type
↳ negative
e^- → conduction band

27. The acceptor atoms in extrinsic p-type semiconductor contribute
a) Holes to conduction band
b) Holes to valence band
c) Electrons to conduction band
d) Electrons to valence band

p-type
↳ positive
e^+ → valence band.

28. The carrier generation is the process by which
a) Electrons are created
b) Holes are created
c) Electrons and holes are created
d) Electrons and holes are annihilated

29. The carrier regeneration is the process by which
a) Electrons and holes are created
b) Electrons and holes are annihilated
c) Electrons are created
d) Holes are created

e^- combine → annihilate
hole
↓
photon is released

30. In thermal equilibrium, the concentrations of electrons and holes are
a) Dependent on time
b) Independent of time
c) Dependent on time and energy
d) Independent of time and energy

= ? dealing with e^- & e^+.

31. The quantum of energy in elastic wave is known as
    a) Photon
    b) Phonon
    c) Electron
    d) Magnon

32. The Phonons are particles that obey
    a) Fermi Dirac statistics
    b) Wiedemann Franz law
    c) Bose Einstein Statistics
    d) Drude Lorentz theory

PART – B

1. What are the merits and demerits of Classical free electron theory?
2. What are the merits and demerits of Quantum free electron theory?
3. Write short notes on direct bandgap semiconductors.
4. Write short notes on indirect bandgap semiconductors.
5. Define intrinsic semiconductors using bandgap in energy levels.
6. Explain the concept of phonons
7. Describe in brief about the First Brillouin zone.
8. How does the band theory differentiate the semiconductors and insulators?
9. What is the influence of dopant on n-type semiconductors?
10. What is the influence of dopant on p-type semiconductors?
11. Define Fermi level. Describe the Fermi Distribution function.
12. How does the *E-k* diagram explain the existence of bandgap in materials?
13. Write note on Effective mass.
14. Describe the concept of periodic potential in crystals.
15. Give the band structure diagram of GaAs and Si crystals.
16. Write down the Fermi distribution function. How does the function vary with temperature?
17. Differentiate between semiconductors and insulators based on band theory.

PART – C

1. Describe free electron theory using classical concepts. Also mention its merits and demerits.
2. Describe free electron theory using quantum concepts. Also mention its merits and demerits.
3. Derive the density of states equation for the concentration of charge carriers.
4. Derive the equation for the band structure of energy in solids using the assumptions of Kronig-Penney model.