Assignment 3 ANSWERS

(1 MARK)

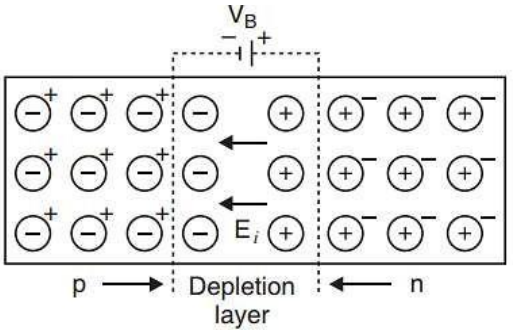
1. c
2. c
3. c
4. a
5. d
6. b
7. a
8. a
9. a
10. a
11. CASE BASED STUDY I:(I) b (II) c (III) a (IV) c
12. CASE BASED STUDY II:(I)b(II) c (III)a (IV) a

(2 MARKS)

13. In n-type semiconductors, electrons are the major charge carriers. In p-type semiconductors, holes are the major charge carriers.

14. P-type semiconductors are made from germanium impurities that include indium. Impurities of a trivalent nature can be added to germanium to generate the P-type material. They are called acceptor impurities because they are trivalent.

15. Because the n-type has more electrons and the p-type has more holes when a p-n junction is formed, the electrons from the n-side diffuse into the p-side & the holes from the p-side diffuse into the n-side.



Potential Barrier

A potential difference between the two regions is established by the buildup of electric charges of opposing polarities in the two regions across the junction. This is referred to as the potential or junction barrier. The potential barrier that has formed across the junction prevents charge carriers from moving from p to n and vice versa. There is a zone on each side of the intersection where

mobile charges have depleted and only immobile charges remain. The depletion layer or zone is the area around the junction that is devoid of any mobile charge carriers.

16: Energy bands : In a solid , the energy of electrons lie within certain range. The energy levels of allowed energy are in the form of bands, these bands are separated by regions of forbidden energy called band gaps.

Distinguish features :

(a) In conductors : valence band and conduction band overlap each other.

In semiconductors : Valence band and conduction band are separated by a small energy gap.

In insulators : They are separated by a large energy gap.

(b) In conductors : Large number of free electrons are available in conduction band.

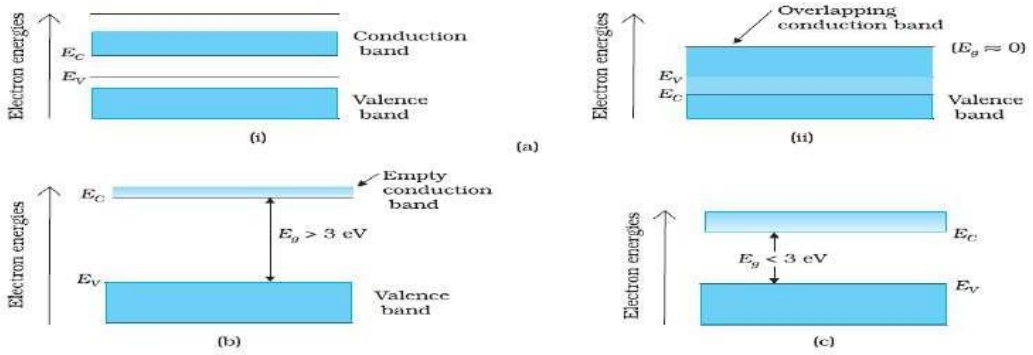
In semiconductor : A very small number of electrons are available for electrical conduction.

In insulators : Conduction band is almost empty i.e., no electron is available for conduction.

Effect of temperature : (i) In conductors : At high temperature , the collisions of electrons become more frequent with the atoms / molecules at lattice site in the metals as a result the conductivity decreases (or resistivity increases).

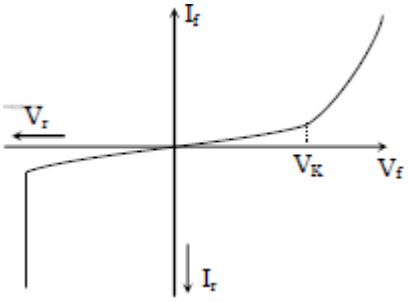
(ii) In semiconductors : As the temperature of the semiconducting material increases, more electrons hole pairs becomes available in the conduction band and valence band , and hence the conductivity increases or the resistivity decreases.

(ii) In insulators : The energy band between conduction band and valence band is very large , so it is unsurpassable for small temperature rise. So , there is no change in their behaviour.



(3 MARKS)

17. V-I Characteristics



(i) When p-n junction is reverse biased, the majority carriers in p and n region are repelled away from the junction. There is small current due to the minority carriers. This current attains its maximum or saturation value immediately and is independent of the applied reverse voltage.

(ii) As the reverse voltage is increased to a certain value, called break down voltage, large amount of covalent bonds in p and n regions are broken. As a result of this, large electron-hole pairs are produced which diffuse through the junction and hence there is a sudden rise in the reverse current. Once break down voltage is reached, the high reverse current may damage the ordinary junction diode.

18.(a) Bulb-B_1 will go as the diode $D_1$is forward biased

(b) Reversed biased.

(5 MARKS)

19.

a) Two important processes involved during the formation of p-n junction are:

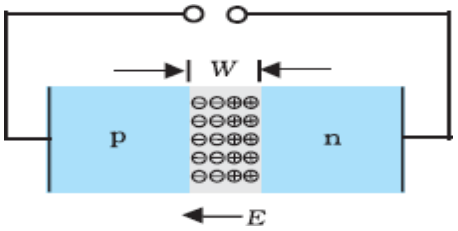
(i) Diffusion and (ii) drift.

As soon as p-type semiconductor comes in contact with n-type semiconductor due to the different concentration gradient to charge carries, the electrons start moving towards p-side and the holes start moving from p-side to n-side. This process is called drift.

Due to diffusion, the positive space charge region is created on the n-side of the junction and the negative space charge region is created on the p-side of the junction. Thios charge develops an electric field (junction field) from n-side to p-side. This field forces the free charges to move. This process is called drift.

Formation of potential barrier : Electrons are the majority charge carries in n-type semiconductor. They move towards p-type semiconductor leaving behind the positive

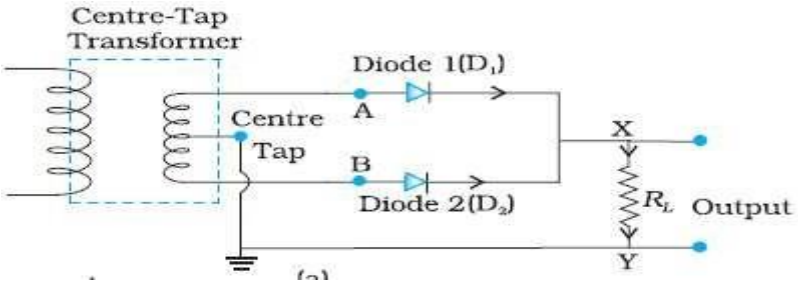
charged ions. Similarly, holes being in majority in the p-type semiconductor, move towards the n-type semiconductor. They leave behind the negatively charged ions. This way the accumulation of charges takes place near the junction. This stops further diffusion of the charges and the potential drop across the function due to these fixed charges is called potential barrier.



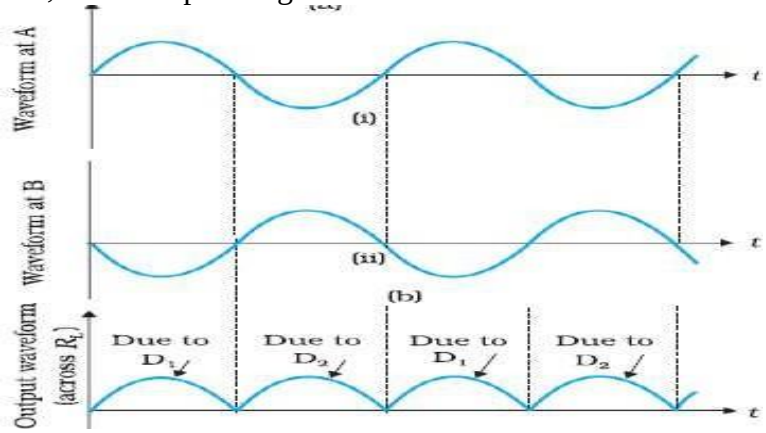
b) (i) In forward bias, the barrier potential decreases.

(ii) In reverse bias, the barrier potential increases.

20. During the first half of the cycle, if A is at higher potential with respect to centre-tap and B is at lower potential, the diode D_1 being forward biased conducts and the diodeD_2 being reverse biased does not conduct. The current flows through the load in thesense H to L.During the second half of the cycle, conditions get reversed and only diodeD_2 conducts Again, the current flows through the load in the sense H to L.



Thus, in the output we get a unidirectional current.



21.

i) (d) Reason : In reverse biased p-n junction, potential difference across a junction becomes ($V+V_B$)

ii) (c)

iii) (b) Reason : D_3 is in R.B. and D_1 is in F.B.

$\therefore$2 Ω and 4 Ω are in series and are connected to 12 V.

$$\therefore \quad I = \frac{12}{2+4} = 2\text{A}$$

iv) (d)