SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS

14 Chapter

EXERCISE

1:

In an n-type silicon, which of the following statements is true:

(a) Electrons are majority carriers and trivalent atoms are the dopants.
(b) Electrons are minority carriers and pentavalent atoms are the dopants.
(c) Holes are minority carriers and pentavalent atoms are the dopants.
(d) Holes are majority carriers and trivalent atoms are the dopants.

Solution:

The correct statement is (c).
In an n-type silicon, the electrons are the majority carriers, while the holes are the minority carries. An n-type semiconductor is obtained when pentavalent atoms, such as phosphorus, are doped in silicon atoms.

2:

Which of the statements given in Exercise 14.1 is true for p-type semiconductor.

Solution:

The correct statement is (d).
In a p-type semiconductor, the holes are the majority carriers, while the holes are the minority carries. A p-type semiconductor is obtained when trivalent atoms, such aluminium, are doped in silicon atoms.

3:

Carbon, silicon and germanium have four valence electrons each. These are characterized by valence and conduction bands separated by energy band gap respectively equal to $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$. Which of the following statements is true?

(a) $(E_g)_{Si} < (E_g)_{Ge} < (E_g)_C$

$(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$

(b) $\left(E_g\right)_C < \left(E_g\right)_{Ge} > \left(E_g\right)_{Si}$

(c) $\left(E_g\right)_C > \left(E_g\right)_{Si} > \left(E_g\right)_{Ge}$

(d) $\left(E_g\right)_C = \left(E_g\right)_{Si} = \left(E_g\right)_{Ge}$

Solution:

The correct answer is (c).

Of the three given elements, the energy band gap of carbon is the maximum and that germanium is the least.

The energy bang gap of the these elements are related as : $\left(E_g\right)_C > \left(E_g\right)_{Si} > \left(E_g\right)_{Ge}$

4:

In an unbiased p-n junction, holes diffuse from the p-region to n-region because

(a) Free electrons in the n-region attract them.

(b) They move across the junction by the potential difference.

(c) Hole concentration in p-region is more as compared to n-region.

(d) All the above.

Solution:

The correct statement is (c).

The diffusion of charge carriers across a junction takes place from the region of higher concentration to the region of lower concentration. In this case, the p-region has greater concentration of holes than the n-region. Hence, in an unbiased p-n junction, holes diffuse from the p-region to the n-region.

5:

When a forward bias is applied to a p-n junction, it

(a) Raises the potential barrier.

(b) Reduce the majority carrier current to zero.

(c) Lower the potential barrier.

(d) None of the above.

Solution:

The correct statement is (c).

When forward bias is applied to a p-n junction, it lower the values of potential barrier. In the case of forward bias, the potential barrier is opposed by the applied voltage. Hence, the potential barrier across the junction gets reduced.

6:

In half-wave rectifier, what is the output frequency if the input frequency is 50Hz. What is the output frequency of a full-wave rectifier for the same input frequency

Solution:

Input frequency = 50Hz

For a half-wave rectifier, the output frequency is equal to the input frequency.

$\therefore$ Output frequency = 50Hz

For a full-wave rectifier, the output frequency is twice the input frequency.

$\therefore$ Output frequency = $2 \times 50 = 100$ Hz