Unit Wise Question Bank

Department: FY BTech **Semester: I** **Academic Year: 2024-25**

Class: FY COMP **Div.:A ,B,C** **Date: 20.12.2024**

Course: Basic Electrical And Electronics Engineering

Unit No. - name	Q. No.	Question	Marks	CO	Blooms Level
Unit 4: Semiconductor Basics and applications	**1.**	**With the help of neat diagram, explain an Intrinsic Semiconductor**	**5**	**4**	**Understanding**

Answer :

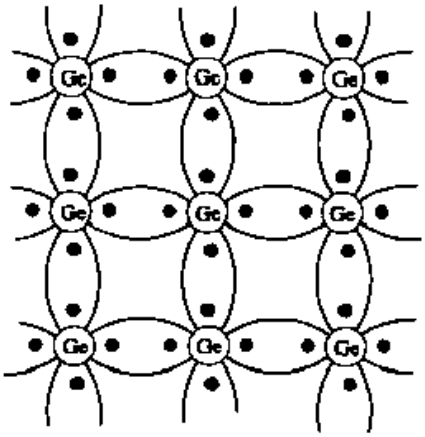
An intrinsic semiconductor is a **pure semiconductor material**

1 Marks

The most common examples of intrinsic semiconductors are silicon (Si) and germanium (Ge).

1 Marks

In a pure intrinsic semiconductor, each atom forms covalent bonds with its neighboring atoms, sharing electrons.



1 Marks

As shown in figure, a Germanium atom has four electrons in its outer shell.

In a crystal lattice, each germanium atom shares one electron with each of its four

nearest neighboring silicon atoms, forming strong covalent bonds.

This creates a stable structure where each silicon atom is surrounded by four other silicon atoms, each sharing one of its electrons.

1 Marks

At absolute zero temperature, no electrons have enough energy to jump from the valence band to the conduction band, so the material behaves as an insulator.

When temperature is increased, some electrons gain sufficient energy to jump to the conduction band resulting flow of current.

1 Marks

2.	**With the help of neat diagram, explain P type Semiconductor**	**5**	**4**	**Understanding**

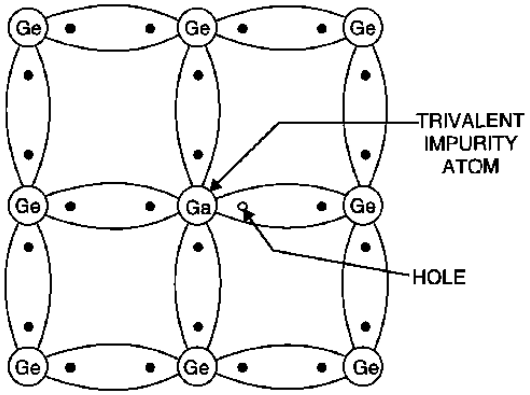
Answer :

It is an impure form of semiconductor.
Here a Trivalent which has 3 valence electrons impurity is added with pure semiconductor material

1 Marks

These impurities are also called as Acceptor Impurities.
An example of Trivalent impurity is Gallium, Boron and etc.

1 Marks



1 Marks

Due to addition of Trivalent impurity, three of the valence electrons get attached with the Ge atoms, to form three covalent bonds.
But, one more electron in germanium remains without forming any bond.

As there is no electron in boron remaining to form a covalent bond, the space is treated as a hole.

1 Marks

Here, hole is a positive charge carrier and hence this type of semiconductor is called as P type semiconductor.
In P type semiconductor, Holes are majority carriers and electrons are minority carriers.

1 Marks

3	**With the help of neat diagram, explain N type Semiconductor.**	**5**	**4**	**Understanding**

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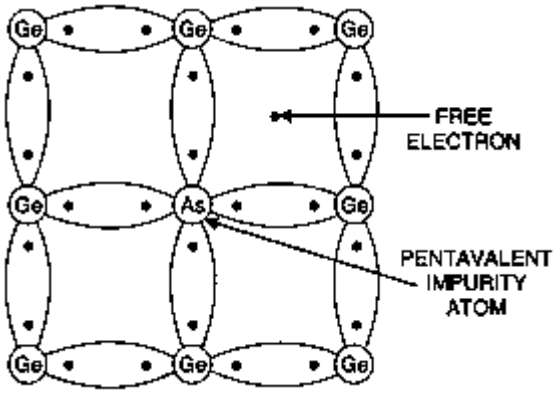
Answer :

It is an impure form of semiconductor.
Here a Pentavalent which has 5 valence electrons impurity is added with pure semiconductor material

1 Marks

These impurities are also called as Donar Impurities.
An example of Trivalent impurity is Arsenic, Antimony and etc.



1 Marks

Due to addition of Pentavalent impurity, four of the valence electrons get attached with the Ge atoms, to form three covalent bonds.
But, one more electron in an impurity remains without forming any bond.
This is called as a free electron.

1 Marks

Here, electron is a negative charge carrier and hence this type of semiconductor is called as N type semiconductor.
In N type semiconductor, electrons are majority carriers and holes are minority

carriers.

1 Marks

4.	**Compare P type and N type semiconductor**	**5**	**4**	**Analyzing**

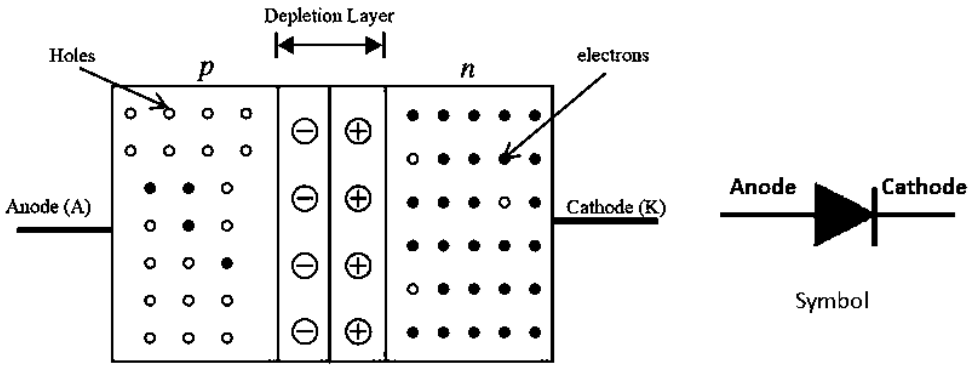
Answer :

P Type Semiconductor	P Type Semiconductor
When a trivalent impurity is added to an intrinsic semiconductor, the obtained semiconductor is known as P-type semiconductor.	When a pentavalent impurity is added to an intrinsic semiconductor, the obtained semiconductor is known as N-type semiconductor.
Example of trivalent impurity : aluminum, gallium, indium, etc	Example of pentavalent impurity : Arsenic, Antimony , etc.
Impurity added creates a vacancy of electron in the structure, known as hole.	Impurities added creates an extra electrons
Trivalant impurities are also called as acceptor impurity	Pentavalant impurities are also called as donor impurity
Holes are the majority carriers	Electrons are the majority carriers
Electrons are the minority carries	Holes are the minority carriers

Each Point carries 01 Marks (At least 05 Points is expected)

5.	**Draw and explain construction of PN junction diode**	**5**	**4**	**Understanding**

Answer :



2 Marks

Diode is an abbreviation of Di-Electrode.
It consists of two electrodes which are connected to two types of semiconductor materials.
The electrodes are named as Anode (A) and cathode (K).

1 Marks

When a p type and n type semiconductor is placed near to each other, it forms a junction.
Thus diode is a Uni junction device.

1 Marks

Due to immobile ions, a depletion layer is formed near junction.

1 Marks

6.	**With the help of neat diagram, explain working principle of PN Junction Diode**	**5**	**4**	**Understanding**

Answer :

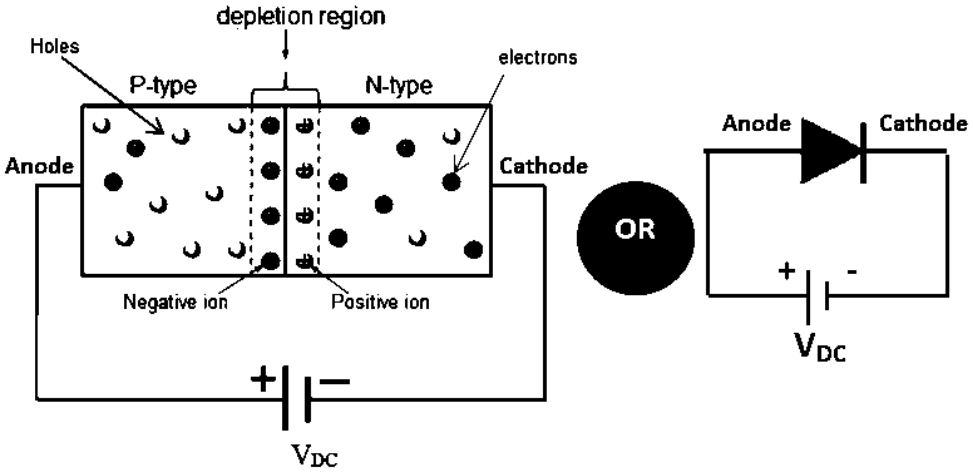
Based on the voltage applied to anode and cathode terminals, diode is operated into two different conditions.

1) Forward Bias Condition
2) Reverse Bias Condition

1 Marks

1) Forward Bias Condition

The p-n junction is said to be forward-biased when the p-type is connected to the positive terminal of the battery and the n-type to the negative terminal as shown in figure



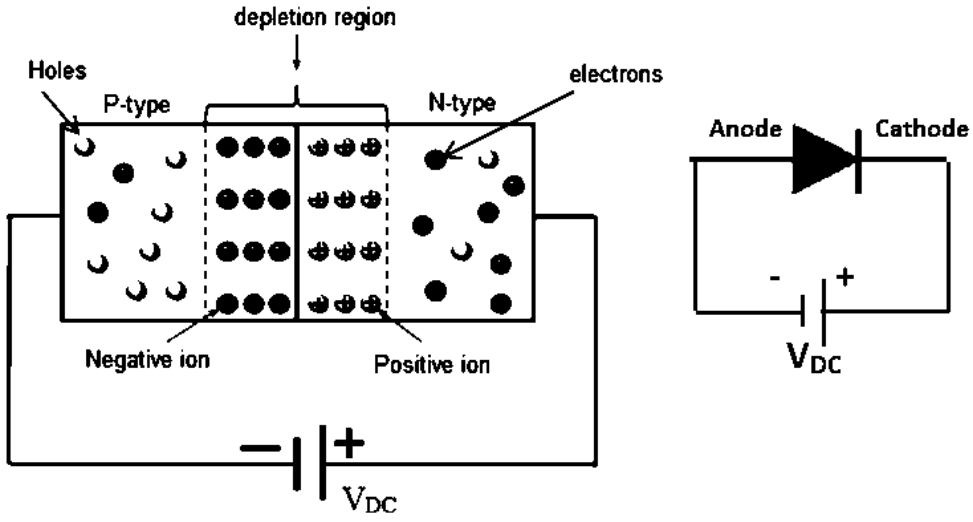
1 Marks

When external DC voltage is applied, due to positive plate of supply, majority carriers (holes) from P type material gets repelled towards junction.
Similarly due to negative plate, electrons from N type material gets repelled towards junction.
When the supply voltage becomes sufficiently large, junction barrier breaks and diode turns ON.

1 Marks

2) Reverse Bias Condition

The p-n junction is said to be reverse-biased when the p-type is connected to the negative terminal of the battery and the n-type to the positive terminal as shown in figure



1 Marks

When external DC voltage is applied, due to negative plate of supply, majority carriers (holes) from P type material gets attracted towards source.
Similarly due to negative plate, an electron from N type material gets attracted towards source.
Due to this, the depletion layer width is increased.
When an applied voltage is increased sufficiently large, an existing covalent bond will break and heavy current flows through diode.

1 Marks

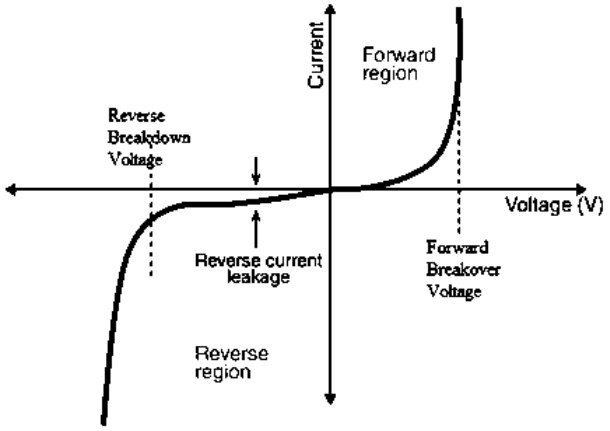
7.	Draw and explain V-I characteristics of PN junction diode	5	4	Understanding

Answer :

We know that diode is operated into two conditions

1) Forward Bias Condition
2) Reverse Bias Condition

Using this a V-I characteristics will be drawn which represents the relation between voltage across diode and current flowing though diode both in forward bias and reverse bias condition



2 Marks

Forward Bias Condition
Here, the p-type is connected to the positive terminal of the battery and the n-type to the negative terminal.

When external DC voltage is applied, due to positive plate of supply, majority carriers (holes) from P type material gets repelled towards junction.
Similarly due to negative plate, electrons from N type material gets repelled towards junction.
When the supply voltage becomes sufficiently large, junction barrier breaks and diode turns ON.
The voltage at which junction breaks is called as Break over voltage

1.5 Marks

Reverse Bias Condition
Here, the p-type is connected to the negative terminal of the battery and the n-type to the positive terminal.

When external DC voltage is applied, due to negative plate of supply, majority carriers (holes) from P type material gets attracted towards source.
Similarly due to negative plate, an electron from N type material gets attracted towards source.
Due to this, the depletion layer width is increased.
When an applied voltage is increased sufficiently large, an existing covalent bond will break and heavy current flows through diode.

The voltage at which reverse bias junction breaks called as reverse breakdown voltage.

1.5 Marks

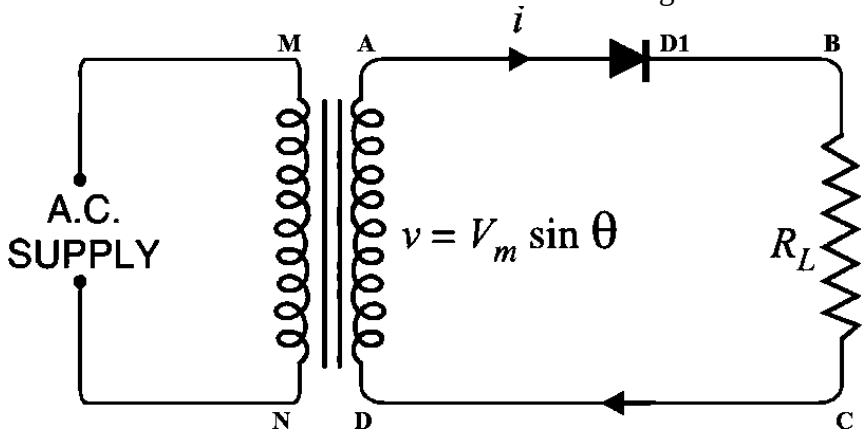
8.	Define Rectifier. Draw and explain working of Half Wave Rectifier. Also sketch input output waveforms	5	4	Applying

Answer :

Rectifier is a device which converts bi directional AC input to uni directional DC output.

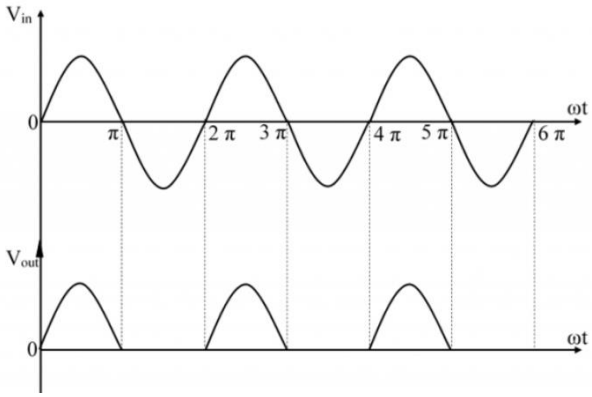
1 Marks

Here, a diode is connected in series with load as shown in figure.



1 Marks

Figure shown input output waveforms of half wave rectifier



1 Marks

For positive half cycle of applied AC input, Diode becomes forward biased.
And thus it turns ON.
Current flows in the circuit as (A-D1-B-RL-C-D).

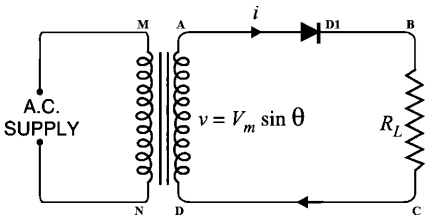
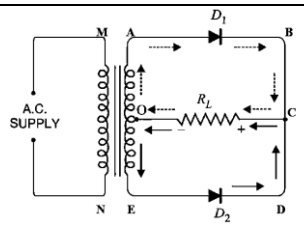
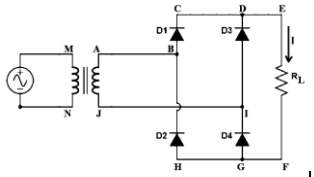
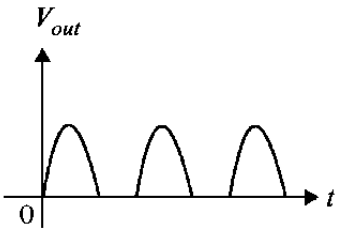
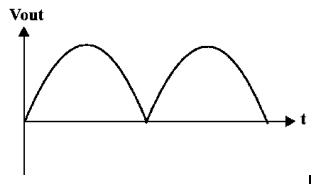
Let us assume, if current flowing through RL is from B to C, it generated positive output.

1 Marks

For negative half cycle of applied AC input, Diode becomes reverse biased.
And thus it turns OFF.
No current flows in the circuit.
Thus we get zero output.

1 Marks

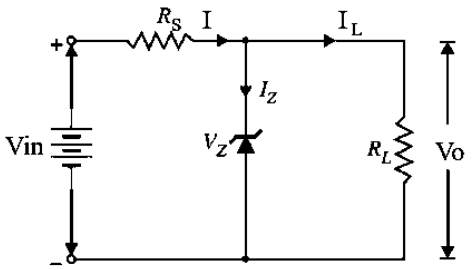
9.	Compare Half Wave Rectifier and Full Wave Rectifier	5	4	Analyzing

Parameter	**Half wave rectifier**	**Full wave rectifier**
Circuit Diagram		 OR 
Output Waveform		
No of Diodes	01	02 OR 04
Output Frequency	$f_o = f_{in}$	$f_o = 2\ f_{in}$
PIV	Vm	Vm (for Center Tap FWR) 2Vm (for Bridge FWR)
DC or Avg Load Current	$\frac{I_m}{\pi}$	$\frac{2\ I_m}{\pi}$
DC or Avg Load Voltage`	$\frac{V_m}{\pi}$	$\frac{2\ V_m}{\pi}$

RMS Load Current	$\frac{I_m}{2}$	$\frac{I_m}{\sqrt{2}}$
RMS Load Voltage`	$\frac{V_m}{2}$	$\frac{V_m}{\sqrt{2}}$
Rectifier Efficiency	40.6 %	81.2

Each Point carries 01 Marks (At least 05 Points is expected)

10.	With neat diagram, explain working of Zener Diode as a Regulator.	5	4	Applying



2 Marks

Regulator is a device which provides constant output voltage irrespective of change in input voltage and or load current.

1 Marks

Here, Zener diode is connected in reverse bias condition.
It is connected across the load resistance.
Rs is a series resistance used as a current limiting resistance.

1 Marks

Since the Zener diode is connected across load resistance,
Vo = Vz
When input voltage is increases, due to the property of Zener diode, its output voltage remains constant.
Thus the voltage across load resistance remains constant.
And we get constant output voltage.

1 Marks

11.	An a.c. supply of 230V is applied to a half wave rectifier circuit through transformer of turns ratio 10 : 1. The diode used is assumed to be ideal and having zero internal resistance Determine • Output DC voltage and PIV	5	4	Evaluating

Solution :

$$V_{RMS1} = 230\,V$$

$$V_{m1} = 2V_{RMS1} = 460\ V$$

1 Marks

$$V_{m2} = V_{m1}\frac{N_2}{N_1} = 46\ V$$

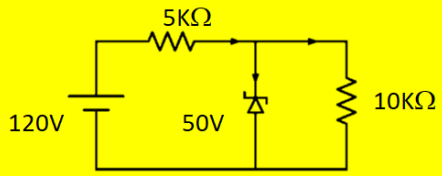
1 Marks

$$V_{dc} = \frac{V_{m2}}{\pi} = 14.64\ V$$

1 Marks

During the negative half cycle of a.c. supply, the diode is reverse biased and hence there is no current flowing. Therefore, the maximum secondary voltage appears across diode is PIV = 46 V

2 Marks

12.	For the circuit shown below,  Determine • The output voltage • Voltage drop across series resistance	5	4	Evaluating

Solution :

From figure,

Given Zener voltage is 50V

1 Marks

And hence Maximum voltage across Zener will be 50V

$$\therefore V_O = 50\ V$$

1.5 Marks

$$V_{in} = V_s + V_Z$$

1 Marks

$$\therefore V_s = 70\ V$$

1.5 Marks

Course Faculty

Dr. Mahesh Navale