

# 15. SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS

## IMP DEFINITIONS & FORMULAS

### SEMI CONDUCTOR MATERIALS

- Semi conductors** are the materials like Si, Ge having electrical conductivity between conductors and insulators
- A **pure semiconductor** (Si or Ge) without doping is called **intrinsic semiconductor**.  
In this,  $n_e = n_h$   
Where  $n_e$  = electron concentration  
 $n_h$  = hole concentration
- A **doped semiconductor** is called **extrinsic semiconductor**. In this,  $n_e \neq n_h$
- Si or Ge doped with pentavalent impurity is called **n-type semiconductor**. In this,  $n_e > n_h$ .
- Si or Ge doped with trivalent impurity is called **p-type semiconductor**. In this,  $n_e < n_h$ .
- p-n junction**: The region where p-type and n-type semi-conductors are in contact with each other is called **p-n junction**.
- p-n junction diode**: The device having a p-n junction is called **p-n junction diode**. Its basic property is to allow current in one direction only.
- The neutral region formed on either sides of the p-n junction due to diffusion of electrons and holes is called **depletion layer**.

### SEMI CONDUCTOR DEVICES

- The device which converts AC into DC is called **rectifier**. The process in which AC converted to DC is called rectification.
- The device which converts only half of the AC wave into DC is called **half wave rectifier**. Only single diode is used in it.

### BULLET MASTER'S

## PHYSI BEATS!

### DIODE



### 15) SEMICONDUCTORS [1 VSAQ+ 1 SAQ]

Semi conductor materials are used to make electronic devices like

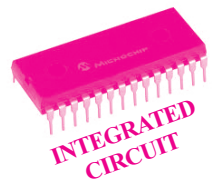
- diodes (p-n junction diode, photo diode, LED, Zener diode)
- Transistor (p-n-p & n-p-n)
- Halfwave, full wave rectifiers
- Integrated circuits and chips.

You Know why **Bangalore** is called **Silicon Valley** of **INDIA** ?

### IPE View

☞ **IMP VSAQ:** Intrinsic & extrinsic semi conductors, p-type & n-type semiconductors, Circuit symbols of p-n-p & n-p-n transistors, Universal gates


☞ **IMP SAQ:** Differences between halfwave and full wave rectifier, Working of full wave rectifier





11. The device which converts full AC wave into DC is called **full wave rectifier**. Two diodes are used in it.

12. Half wave rectifier, Efficiency  $\eta = \frac{0.406R_L}{r_f + R_L}$

13. Full wave rectifier, Efficiency  $\eta = \frac{0.812R_L}{r_f + R_L}$

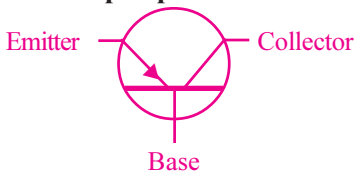
14. A properly doped diode with sharp break down zener voltage in reverse bias is called **zener diode**. It is always used in reverse bias. Symbol of zener diode is . Zener diode is used as voltage regulator.

15. The diode which detects light is called **photodiode**. It works on the principle of photovoltaic effect. Symbol of photodiode is .

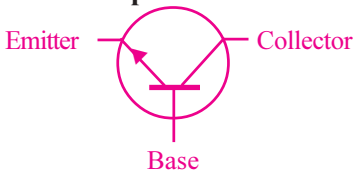
16. The diode which produces light is called **light emitting diode (LED)**. Symbol of LED is . LED is connected in forward bias.

17. A semiconductor device having two p-n junctions is called **transistor**. trans(fer) + (res)istor = transistor

18. Symbol of p-n-p transistor:



19. Symbol of n-p-n transistor:




20. Amplification factor for voltage is  $A_V = \frac{V_o}{V_i}$

21. Relation between  $A_V$  and  $\beta$  is  $A_V = \beta \frac{R_L}{R_i}$

## LOGIC GATES


22. NOT gate:

Symbol  
A   $Y = \bar{A}$

NOT gate-Truth Table

Input	Output
A	Y
0	1
1	0


23. OR gate :

Symbol  
A   $Y = A + B$

OR gate-Truth Table

Input		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1


24. NOR gate :

Symbol  
A   $Y = \overline{A + B}$

NOR gate-Truth Table

Input		Output
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0


25. AND gate :

Symbol  
A   $Y = A \cdot B$

AND gate-Truth Table

Input		Output
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

26. NAND gate:

Symbol  
A   $Y = \overline{A \cdot B}$

NAND gate-Truth Table

Input		Output
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0