SYNOPSIS

Classification of solids: Solids can be classified as metals, insulators and semiconductors basing on conductivity(or) band theory

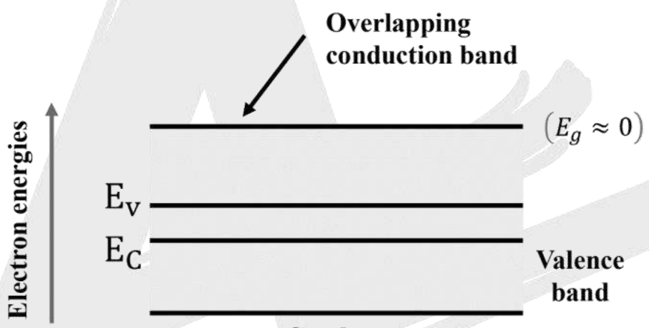
Energy Band theory in solids: An isolated atom has well defined energy levels and energy of an electron depends on its orbit (Principal quantum number)

- Depending on the forbidden energy gap between valence band and conduction band, the solids are classified as conductors, insulators and semiconductors.

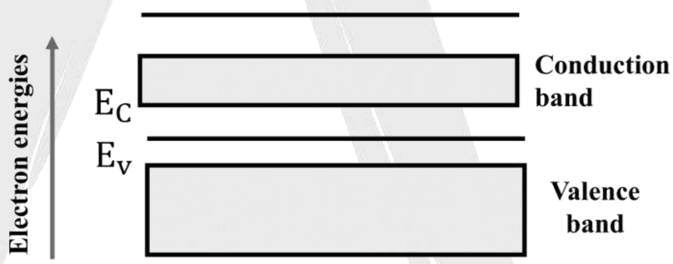
(1) Conductors: The energy band structure in conductors have two possibilities

- The valence band may be completely filled and the conduction band partially filled with an extremely small energy gap between them E = 0

E.g. : Sodium(Na)



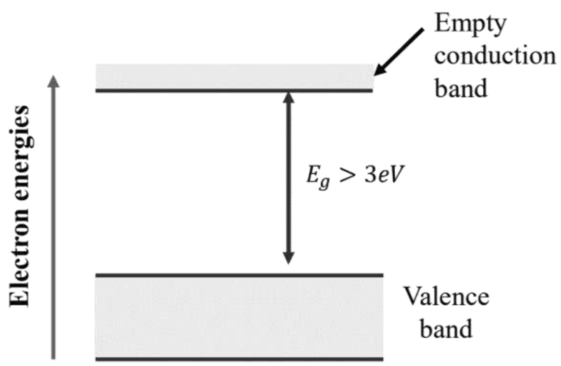
Conductors



Conductors

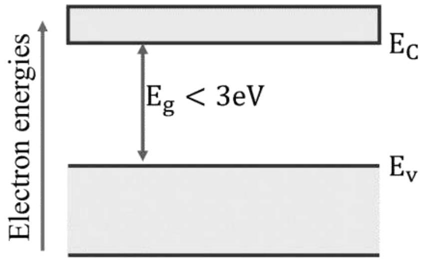
(2) Insulators: In insulators for bidden energy gap is quite large. $E_g > 3eV$

E.g., Energy gap for diamond is 5.5eV.



Insulators

(3) **Semiconductors:** Semiconductors are the basic materials used in the present solid-state devices like diode, transistor, Ic's.



Semiconductors

Intrinsic semi-conductor:

Semiconductors in their purest form having equal number of electrons in CB and holes in VB is called as intrinsic semi-conductors.

Doping:

The process of adding impurity to a pure semi-conductor (in 1 : 10° ratio also called 1ppm). So as to improve its conductivity is called doping.

- Pentavalent impurity atoms are called donor impurity atoms.
- Trivalent impurity atoms are called acceptor impurity atoms.

Extrinsic semiconductor:

The semi-conductor formed by adding a small quantity of impurity (tri or pentavalent) to pure semiconductor is called as extrinsic semiconductor.

The Energy Gap:

Experimentally it has been found that for forbidden region E_g depends on temperature.

For silicon $E_g(T) = 1.21 = 3.60 \times 10^{-4}T$

For germanium $E_g(T) = 0.785 - 2.23 \times 10^{-4}T$

- In semi-conductors the total current I is the sum of electron current I_e and holes current I_h

  $I = I_e + I_h$

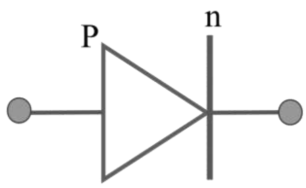
- Electrical conductivity $\sigma = \sigma_e + \sigma_h$

  $\sigma = n_e\mu_e e + n_h\mu_h e$

  For intrinsic semiconductor $n_e = n_h = n_i$ so that $\sigma = n_i e(\mu_e + \mu_h)$

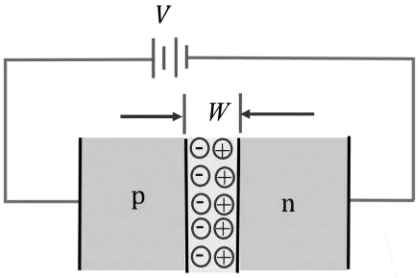
P-n junction: In a single Ge (or) Si crystal by doping one part with trivalent impurity and the other part with pentavalent impurity, a p - n junction is formed.

- If potential barrier is V_b, width of depletion layer is d then $E = \frac{V_b}{d}$.
- The symbol of p-n junction diode is given below

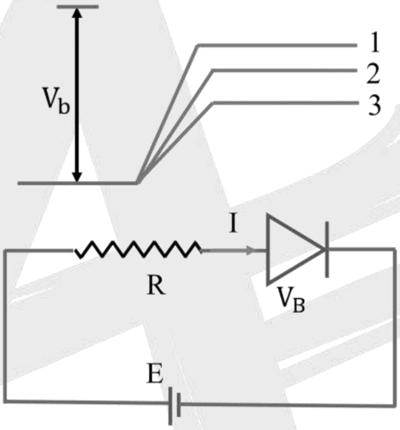


Semi conductor diode :

(1) Forward bias:

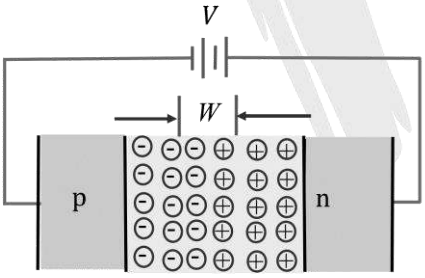


- When an external voltage V is applied across a semiconductor diode such that p-type is connected to +ve terminal and n-type to -ve terminal of battery (in general p - type to high voltage and n-type to low voltage), the diode is said to be forward biased.



$$I = \frac{E - V_B}{R + r_f}$$

(2) Reverse bias:



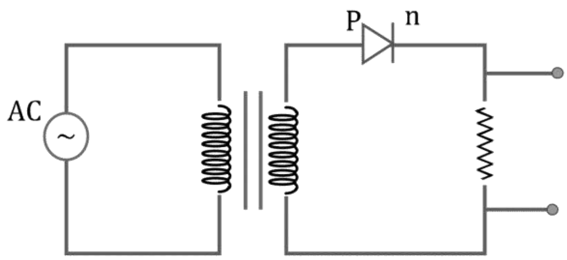
- When an external voltage V is applied across a semiconductor diode such that p-type is connected to -ve terminal and n-type to +ve terminal of battery (in general p - type to low voltage and n-type to high voltage), the diode is said to be reverse biased.

Fig: Diode under reverse bias, Barrier potential under reverse bias.

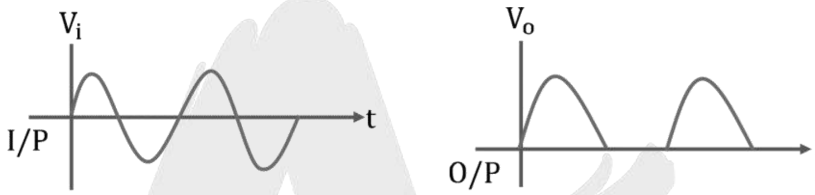
Application of junction diode as a Rectifier:

The process of conversion of ac to dc is called rectification, the arrangement is called rectifier. They are

- Half wave rectifier



Half Wave Rectifier

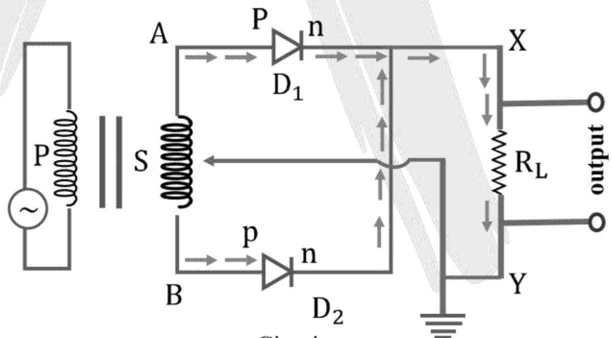


$$\eta = \frac{0.406}{1+\frac{r_f}{R_L}}$$

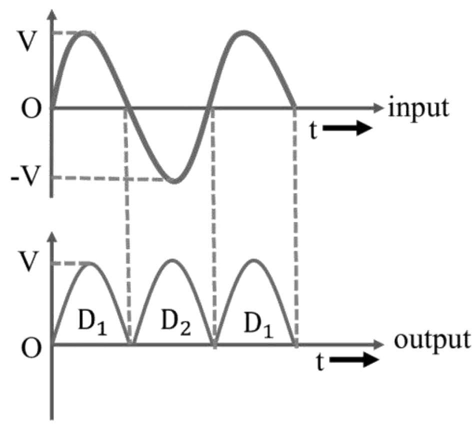
The efficiency is maximum when r_f is negligible.

$\eta_{max} = 40.6\%$

- **Full wave rectifier**



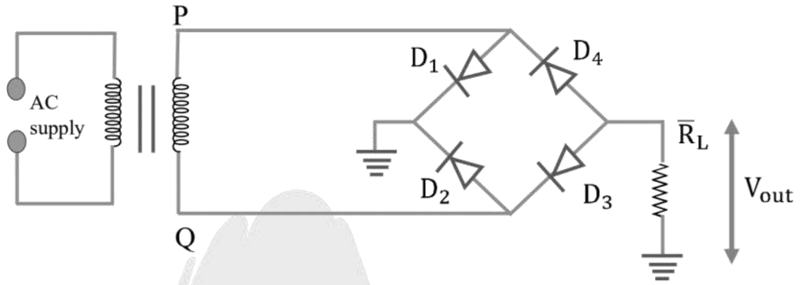
Circuit

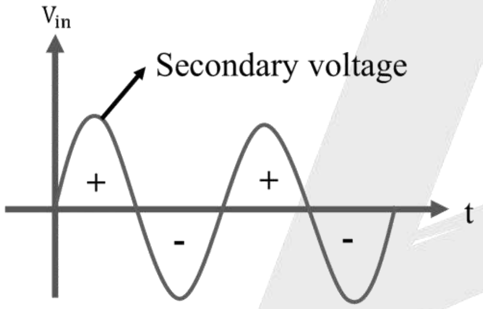


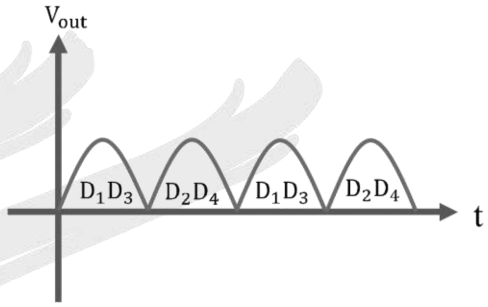
- In full wave rectifier the efficiency is $\eta = 0.812\frac{R_L}{r_f + R_L}$. Its maximum value of 81.2% (where r_f $\rightarrow$ forward resistance of diode and R_L $\rightarrow$ load resistance).

Full-wave bridge rectifier:

In a centre tap full-wave rectifier, it is difficult to locate the centre tap on the secondary winding, which can be overcome in bridge rectifier.







Ripple factor:

The ratio of r.m.s value of a.c. component to d.c. component in the rectifier output is called ripple factor.

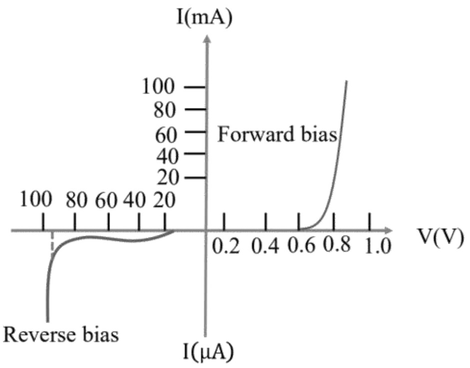
Ripple factor = $\frac{I_{a.c.}}{I_{d.c.}} = \sqrt{\left(\frac{I_{r.m.s}}{I_{d.c}}\right)^2 - 1}$

(ii) For full-wave rectification

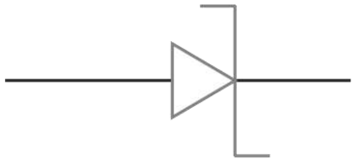
Ripple factor = $\sqrt{\left(\frac{I_m/\sqrt{2}}{2I_m/\pi}\right)^2 - 1} = 0.48$

(1) Zener diode:

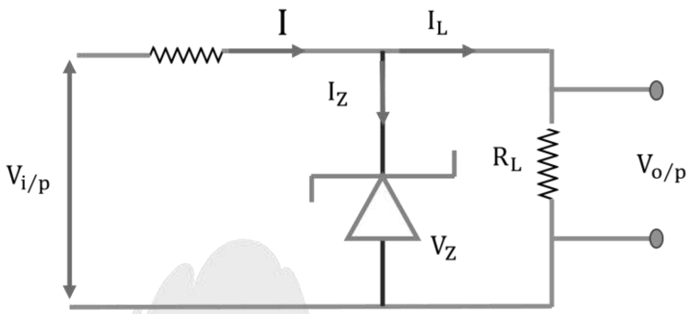
A heavily doped pn junction diode used to operate in reverse bias is called zener diode.



- Symbol of Zener diode is



- Zener diode is used as voltage regulator its circuit diagram is



(2) Opto electronic junction devices photodiode

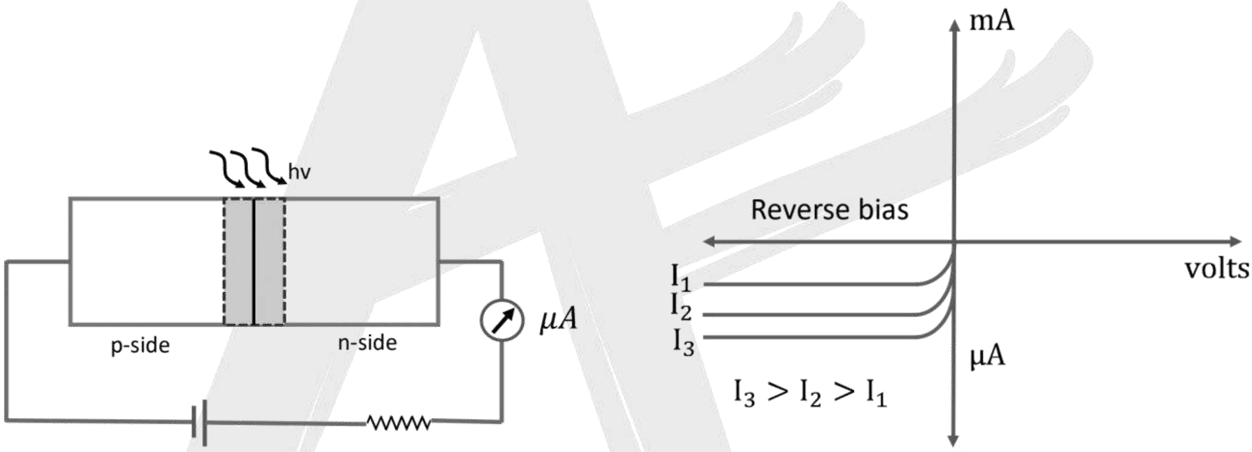
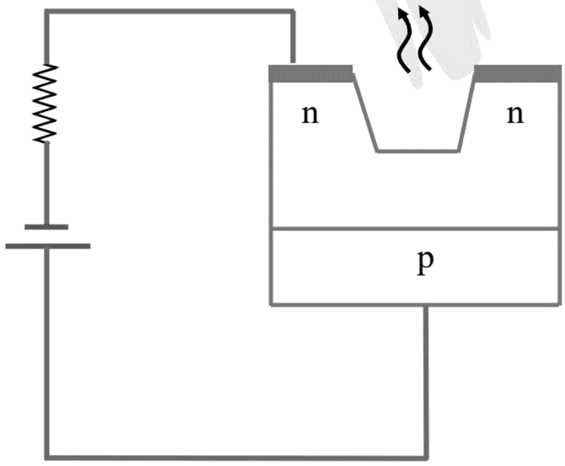
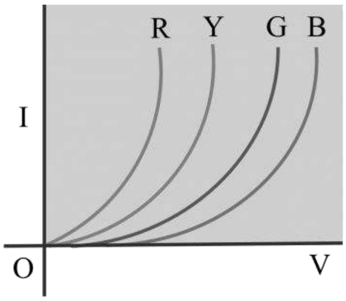


Fig: I – V characteristics of a photodiode for different illumination intensity $I_3 > I_2 > I_1$.

Light Emitting Light (LED)



- Light-emitting diode (LED) is a forward-biased p-n junction diode which emits visible light when energized.



The I-V characteristics of L.E.D:

Solar Cell:

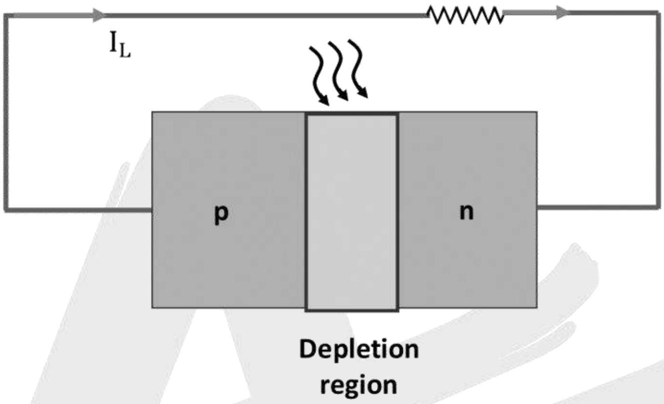


Fig: Atypical illuminated p-n junction solar cell

- Unlike a photodiode, a solar cell is not given any biasing. It supplies emf like an ordinary cell.

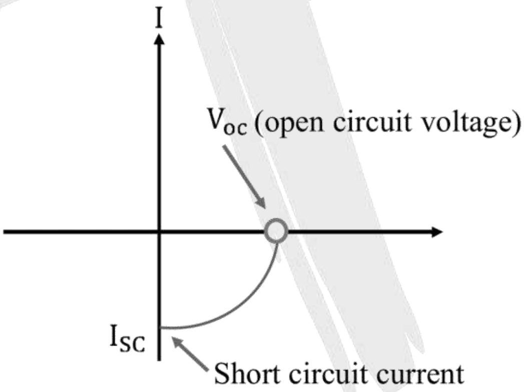
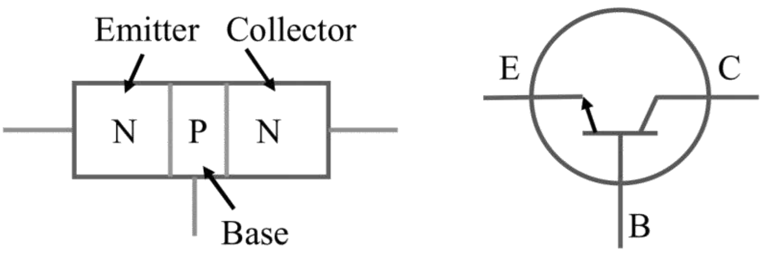


Fig : I- V characteristics of a solar cell

Transistors: Transfer + resistor = Transistor

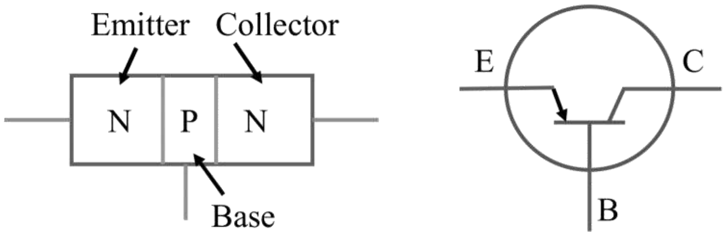
- Transistors are current operated solid-state devices.

In an n-p-n Transistor:



- The emitter current (I_E) is the sum of base current (I_B) and collector current (I_C), i.e., $I_E = I_B + I_C$

In a p-n-p Transistor:



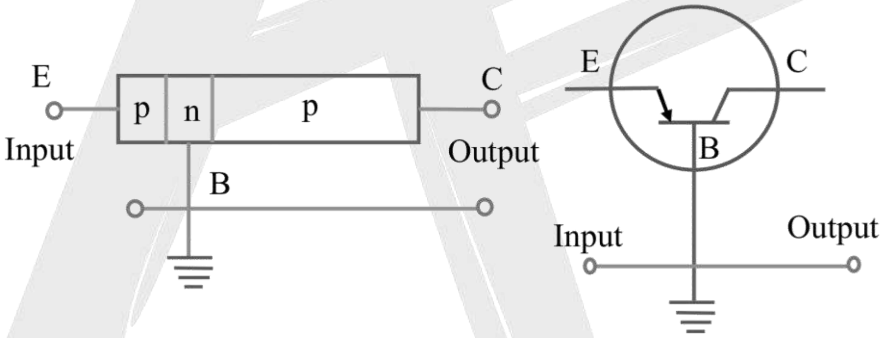
- The current is due to holes inside as they are the majority charge carriers and due to electrons outside the p-n-p transistor.

  The collector current is less than the emitter current $(I_C < I_E)$

Transistor Configurations:

Common Base Configuration: In this configuration base is common to both input and output.

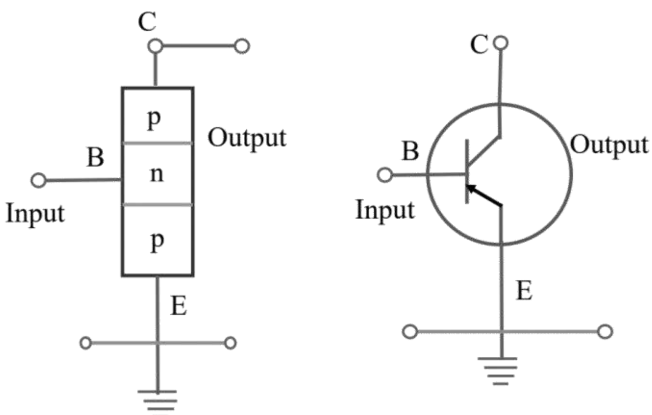
This mode is called grounded base configuration.



- Current amplification factor of common base configuration for ac $\alpha = \left(\frac{\Delta I_C}{\Delta I_E}\right)_{\text{cons tan t} V_{CB}}$
- Current application factor of common base configuration for dc $\alpha = \frac{I_C}{I_E}$

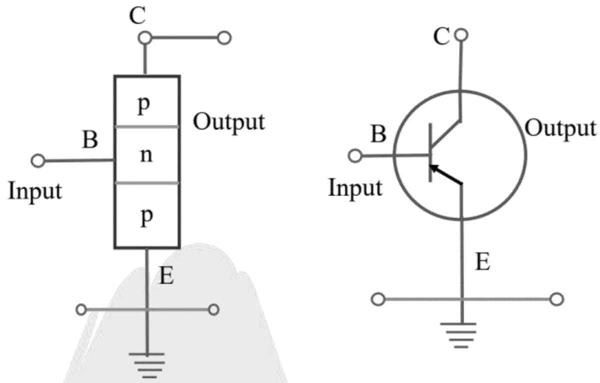
Common Emitter configuration: In this configuration emitter is common to both input and output.

- This mode is called grounded emitter configuration.



- Current amplification factor of common emitter configuration for ac $\beta = \left(\frac{\Delta I_C}{\Delta I_B}\right)_{\text{constant } V_{CE}}$
- Current amplification factor of common emitter configuration for dc $\beta = \frac{I_c}{I_B}$

Common collector configuration: In this configuration collector is common to both input and output.



- Current amplification factor of common collector configuration for ac $\gamma = \left(\frac{\Delta I_E}{\Delta I_B}\right)_{\text{cons tan t} V_{CE}}$
- Current amplification factor of common collector configuration for dc $\gamma = \frac{I_E}{I_B}$

Relation between α & β : -

Relation between α, β and γ: $\gamma = \frac{\Delta I_E}{\Delta I_B} = \frac{1}{1-\alpha} = \frac{\beta}{\alpha} = \beta + 1$

Transistor as an Amplifier

(CE configuration)

The process of raising the strength of weak input signal to a strong output signal is called 'amplification'.

Amplifiers are of two types

(1) Power amplifiers (2) Voltage amplifiers

(1) Power amplifier: Amplifier which is used to raise the power level is known as "Power amplifier."

(2) Voltage amplifier: The amplifier which is used to raise voltage level is known as voltage amplifier.

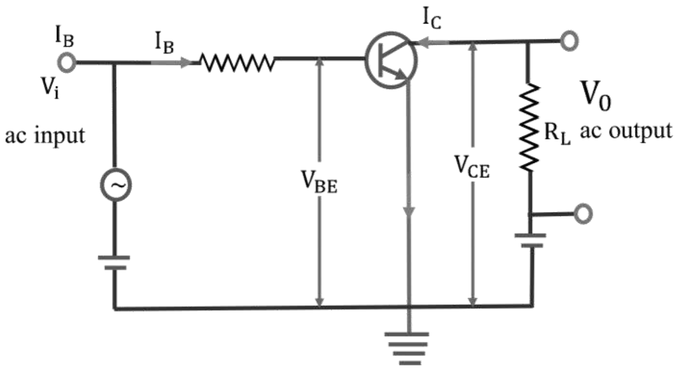


Fig: NPN TRANSISTOR AS AMPLIFIER

Digital Electronics

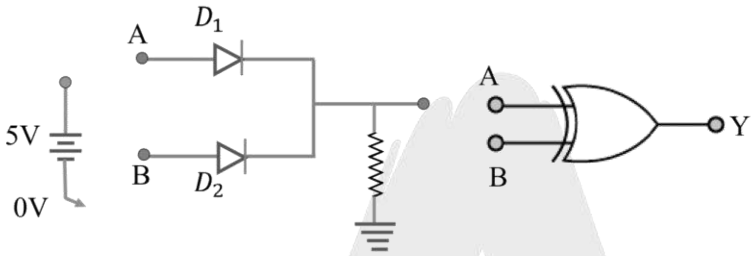
Logic gates: Digital circuit having a certain logical relationship between the input and the output voltages is called a logic gate.

There are three basic logic gates

(1) OR gate (2) AND gate (3) NOT gate

- The OR gate

(1) It is a logic gate which has two or more inputs and one output.



OR gate

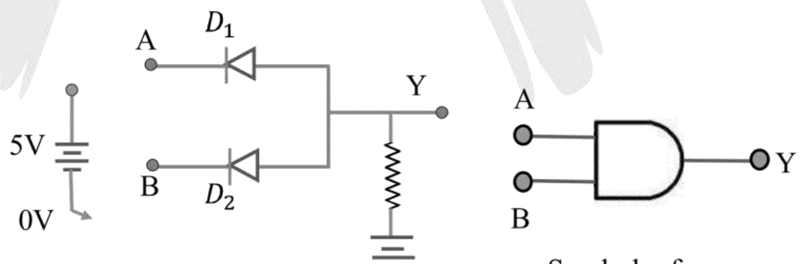
- If it's one or more inputs are high, then is output will be high. Therefore, it has a logic of OR.

Boolean expression for OR gate: A+ B = Y which reads as A OR B is equal to Y.

- Truth table for OR gate -

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

- **The AND gate:** It is logic gate which has two or more inputs and one output.



Circuit of AND gate

Symbol of AND gate

- If it's all inputs are high, then it is output will be high

(1) Therefore it has a logic of AND.

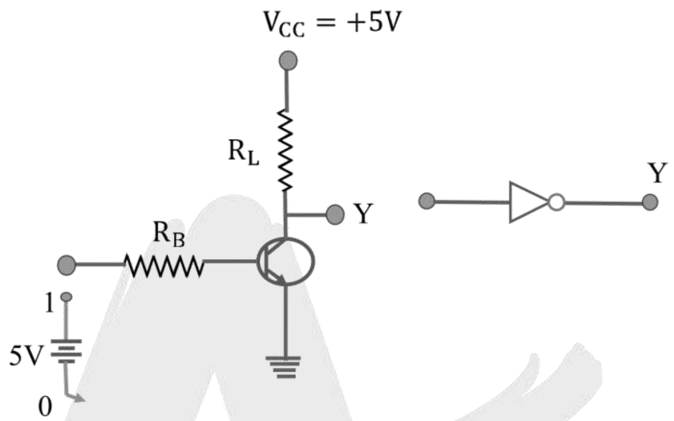
- **Boolean expression for AND gate:**

A. B = Y reads as A AND B is equal to Y.

- Truth table for AND gate

A	B	Y = A.B
0	0	0
0	1	0
1	0	0
1	1	1

The NOT gate: It is the logic gate which has one input and one output



Circual of NOT gate Symbol of NOT gate

If its input is high (1), then its output will be low(0).

Therefore, it has a logic of NOT.

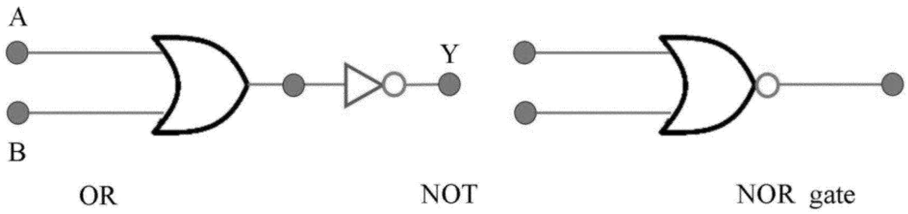
Boolean expression for NOT gate: $\bar{A} = Y$

reads as 'A NOT is equal to Y'.

Truth table for NOT gate

A	$Y = \bar{A}$
0	1
1	0

- **NOR gate:** This logic gate is the combination of OR gate and NOT gate. OR + NOT = NOR
- In this logic gate the output of OR gate is given to the input of NOT gate as shown in the below figure.



- Boolean expression for NOR gate:

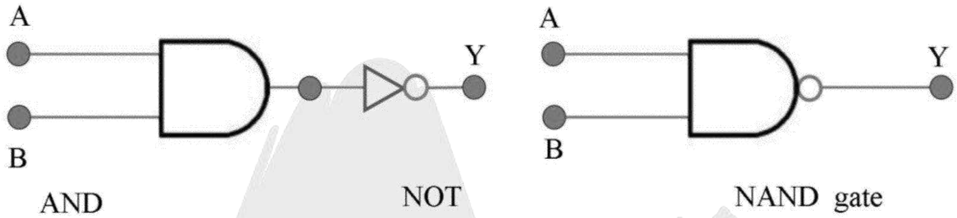
  $Y = \overline{A + B}$. Which reads as A OR B negated.
- Truth table for NOT gate

A. B	A+B		$Y = \overline{A+B}$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

- **NAND gate:** This logic gate is the combination of AND gate and NOT gate.

  AND + NOT $\rightarrow$ NAND

- In this logic gate the output of AND gate is given to the input of NOT gate as shown below

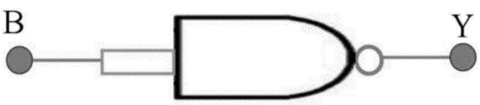


- Boolean expression for NAND gate $Y = \overline{A.B}$
- Truth table for NAND gate

A B	A.B	$\overline{A.B}$	
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

Uses of NOR gate and NAND gate: The NAND gate and NOR gates are the building blocks digital circuits. All the basic gates (OR, AND and NOT) can be obtained by the repeated use of NAND or NOR gates.

NOT gate from NAND gate:

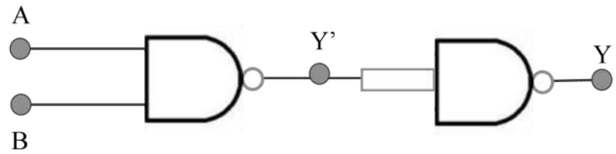


(2) Truth table

A	**B**	$Y = \overline{A.A} = \overline{A}$
0	0	1
1	1	0

AND gate from NAND gate

(1) Diagram

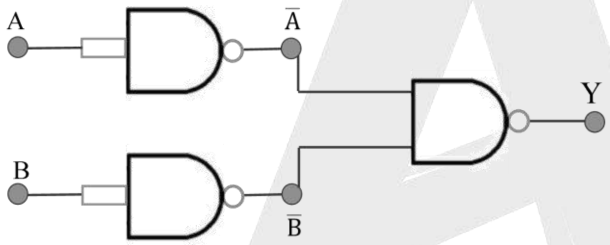


(2) Truth table

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR gate from NAND gate

(1) Diagram

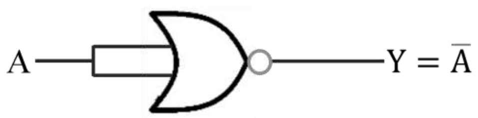


(2) Truth table

A	B	$\overline{A}$	$\overline{B}$	$Y=(A+B)$
0	0	1	1	0
1	0	0	1	1
0	1	1	0	1
1	1	0	1	1

NOT gate from NOR gate

(1) Diagram

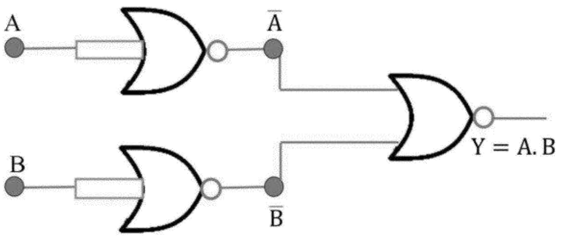


(2) Truth table

A	B	$Y=\overline{A.A}=\overline{A}$
0	0	1
1	1	0

AND gate from NOR gate

(1) Diagram



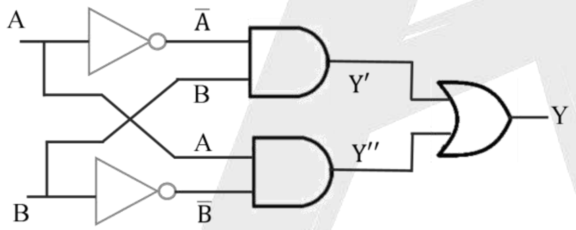
(2) Truth table

A	**B**	**Y**
0	**0**	**0**
0	**1**	**0**
1	**0**	**0**
1	**1**	**1**

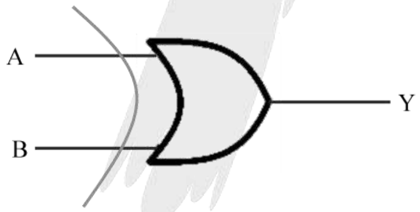
XOR GATE: XOR gate is obtained by using OR, AND and NOT gates. It is also called exclusive OR gate.

- The output of a two input XOR gate is 1 only when the two inputs are different.
- The Boolean equation is $Y = A.\overline{B} + B.\overline{A}$

(1) two input XOR gate



(2) circuit symbol



(3) truth table

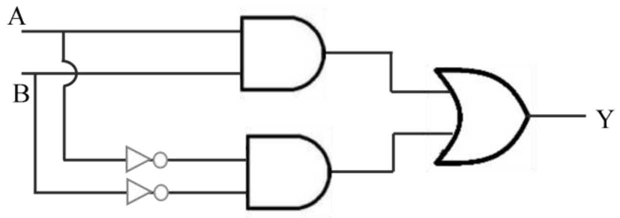
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

XNOR GATE: XNOR gate is obtained by using OR, AND and NOT gates.

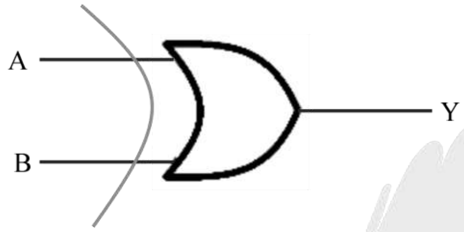
- It is also called exclusive NOR gate.
- The output of a two input XNOR gate is 1 only when both the inputs are same.

The Boolean equation is $Y = A.B + \bar{A}.\bar{B}$ XNOR gate is inverse of XOR gate.

(1) Diagram



(2) circuit symbol



(3) truth table

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

COMMUNICATION SYSTEMS

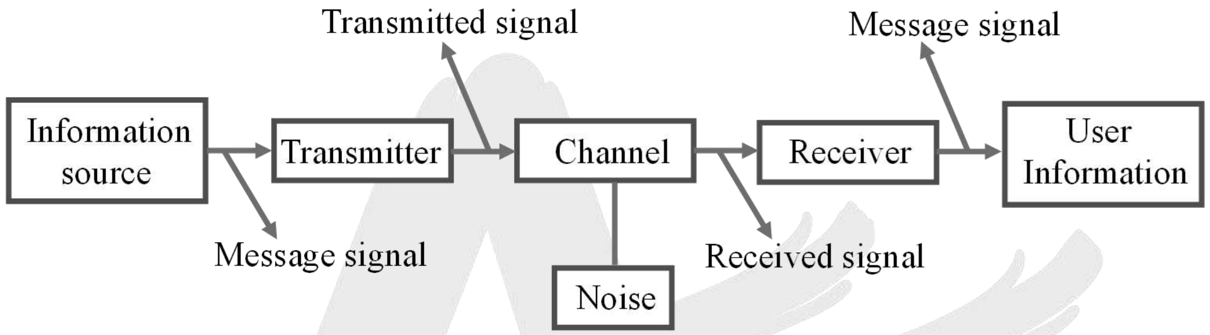
Communication is basically of two types :

(a) **Point to point : -** This takes place between a transmitter and a receiver. Telephonic conversion between two persons is a good example of it.

(b) **Broad cast mode :** Here, a large number of receivers receive the information from a single transmitter. Radio and television are good examples of broadcast mode.

Elements of Communication System

Basic units of a communication system.



(a) **Transmitter :** The part of the communication system, which sends out the information is called transmitter.

(b) **Transmission channel :** The medium or the link, which transfers message signal from the transmitter to the receiver of a communication system is called channel.

(c) **Receiver :** The part of the communication system, which picks up the information sent out by the transmitter is called receiver. The receiver consists of

➢ **COMMUNICATION CHANNELS :**

Communication channel.

(1) Space communication

(i) Ground wave propagation

(ii) Space wave proparation. (Tropospheric wave propagation. Surface wave propagation.)

(iii) Sky wave propagation : A new dimension recently added to space communication is satellite communication.

(2) Line communication

(i) Two wire transmission line

(ii) Coaxial cable

(iii) Optical fibre cable

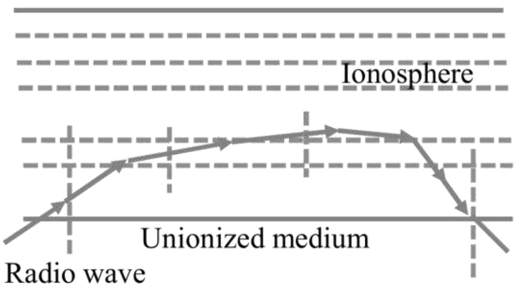
KENNELY HEAVISIDE LAYER :

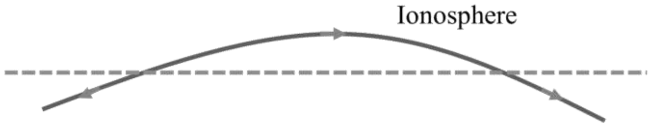
At 110 km above the surface of earth the concentration of electrons is very large. This layer is called Kennely heaviside layer.

	Ground Wave Propagation	Sky Wave Propagation	Space Wave Propagation
Channel	Ground	Layers of atmosphere	Line of sight communication
Method	Wave glides over the surface of earth diffraction effect	Due to reflection of radio waves from the layers having higher electron density	The radio waves travel from transmitting antenna to receiving antenna along a straight line
Frequency	Depends on power and frequency Less than 2MHz	3 MHz to 30 MHz	Greater than 40 MHz
Uses	In medium wave Broad casting	Short wave broadcasting	FM broadcasting and microwave lings
Range	Depends on height of the Antenna and Curvature of earth	Depends on the angle of incidence on the ionosphere. 150 km to 3000 km	Due to curvature of the earth the waves are blocked at a point
Attenuation	Attenuation increases with frequency		

➢ **Ground wave propagation :** In this method, the radio waves are guided along the surface. The wave induces charges on the earth. These charges travel with the wave and this forms a current. Now the earth behaves like a leaky capacitor in carrying the induced current. The wave loses some energy, as energy is spent due to flow of charge through the earth's resistance.

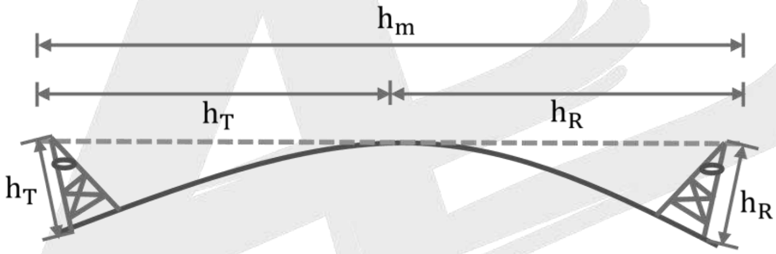
➢ **Sky wave propagation :** Above 2MHz and upto 30MHz, long distance communication takes place through ionosphere. The ionosphere reflects the radio waves back to the earth. This method is called sky wave propagation. It is used for shortwave broad casting services. Ionosphere is a thick blanket of 65 km to 400 km above the earth's surface.





The sky wave propagation can cover a very long distance and so round the globe communication is possible.

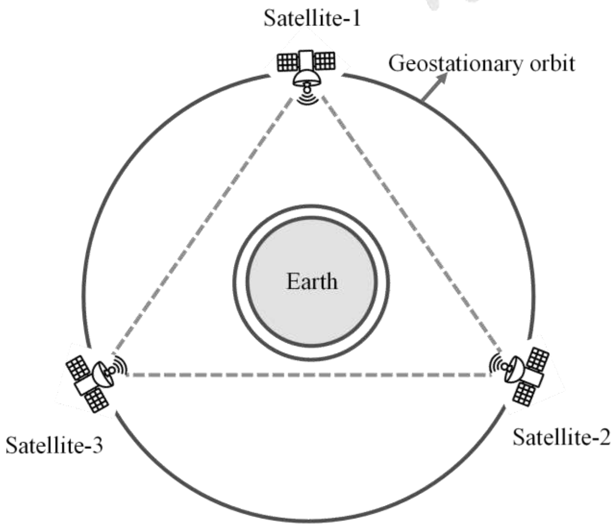
Wave propagation : The method is used for line-of-sight [LOS] communication and also for satellite communication. At frequencies above 40MHz, communication is mainly by LOS method.



If the receiving antenna is at a height h_R, the distance to the horizon d_R is $d_R = \sqrt{2Rh_R}$

$\therefore$ The maximum distance d_M between the two antennas is $d_M = \sqrt{2Rh_T} + \sqrt{RH_R}$ where

Satellite Communication : Long distance communication beyond 10 to 20 MHz was not possible before 1960 because all the three modes of communication discussed above failed (ground waves due to conduction losses, space wave due to limited line of sight and sky wave due to the penetration of the ionosphere by the high frequencies beyond f_c).



- **2. LINE COMMUNICATION**

Line communication means interconnection of two points with the help of wires for exchange of information. There are three principal types

(i) Two Wire Transmission Line

(ii) Coaxial wire lines (coaxial cables)

(iii) optical fibers

- **Two Wire Transmission Line**

The most commonly used two wire lines are :

Parallel wire, twisted pair wires and co-axial cable.

(1) Parallel wire line : In a two wire transmission line, two metallic wires (may be hard or flexible) are arranged parallel to each other inside a protective insulation coating.

(2) Twosted pair wire : It consists of two insulated copper wires twisted around each other at regular intervals to minimize electrical interference (to connect telephone system).

- **Coaxial wire lines :** It consists of a central copper wire (which transmits surrounded by a PVC insulation over which a sleeve of copper mesh (outer conductor) is placed.

- **OPTICAL COMMUNICATION**

The use of optical carrier waves for transmission of information from one place to another is called optical communication.

Basic optical communication link is a point to point link having transmitter at one end, receiver at the other end and consists of three components namely

(1) Optical source and modulator

(2) Optical signal detector or photodetector

(3) Optial fibre cable through which optical signal is transmitted.

- **MODULATION AND ITS NECESSITY :**

Message signals are also called base band signals. Which essentially designate the band of frequencies representing the original signal, as delivered by the source of information.

Size of antenna : This antenna should have a size comparable to the wavelength of the signal. For an electromagnetic wave of frequency 20kHz, wavelength is 15km.

The linear size of the antenna must be the order of the wavelength and for effective transmissin its length must be $h = \frac{\lambda}{4}$ so that antenna properly senses the time variation of the signal.

- **Effective power radiated by an antenna**

Power radiated by an antenna is proportional to $\left(\frac{\ell}{\lambda^2}\right)$. Where ℓ is length of the antenna.

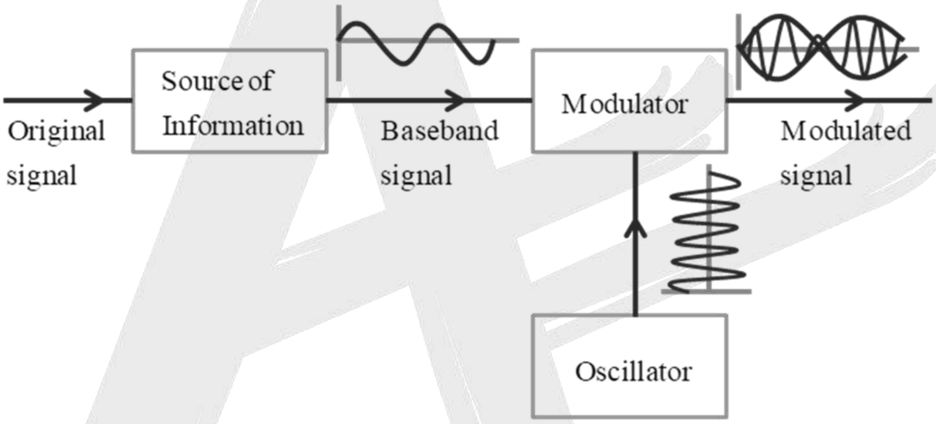
- **Mixing up of signals from different transmitters**

  Suppose many people are talking at the same time or many transmitters are transmitting baseband information signals simultaneously. All these signals will get mixed up and there is no simple way to distnguish between them. This points out towards a possible solution by using communication at high frequencies and alloting a band of frequencies to each message signal for its transmission.

  In doing so, we take the help of a high frequency signal, known as the carrier wave, and a process known as modulation which attaches information to it.

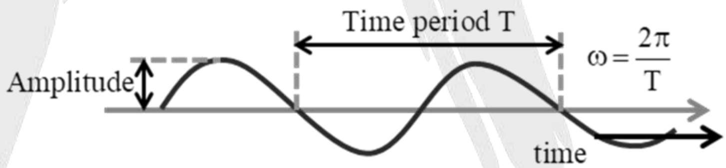
Modulation:

The process of superimposing information contained in the low frequency, messages signal on a high frequency carrier wave, near transmitter is known as modulation.

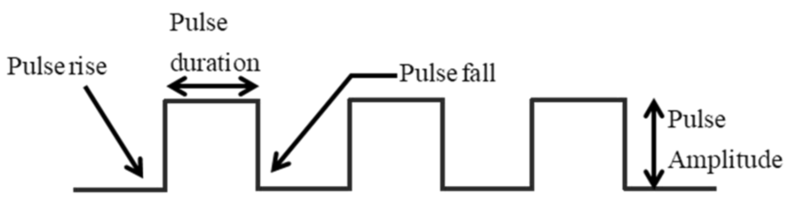


- **Types of Modulations:**

  The carrier wave may be continuous (sinusoidal) or in the form of pulses as shown in figure.



(a)



(b)

Therefore depending upon the specific characteristic of carrier wave which is being varied in accordance with the message signal, modulation can basically be differentiated as

(i) continuous wave modulation; and

(ii) Pulse wave modulation

- **Accordinag to the type of modulation**

  For sinusoidal continuous carrier waves

  (i) Amplitude Modulation (AM)

  (ii) Frequency Modulation (FM)

  (iii) Phase Modulation

- **For pulsed carrier waves**

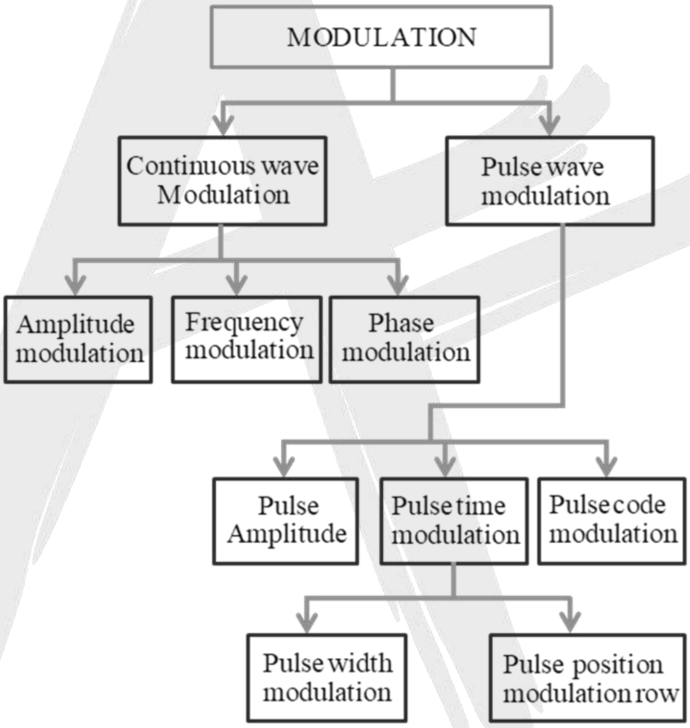
  (i) Pulse Amplitude Modulation (PAM)

  (ii) Pulse Time Modulation (PTM)

  (a) Pulse Position Modulation (PPM)

  (b) Pulse Width Modulation (PWM) or Pulse Duration Modulation (PDM)

  (iii) Pulse Code Modulation (PCM)



(I) Continuous Wave Modulation

During the process of modulation, any of the two parameters, viz amplitude of phase angle, of the carrier wave can be controlled by the message or information signal. This resultant in two types of modulations:

(i) Amplitude modulation (AM)

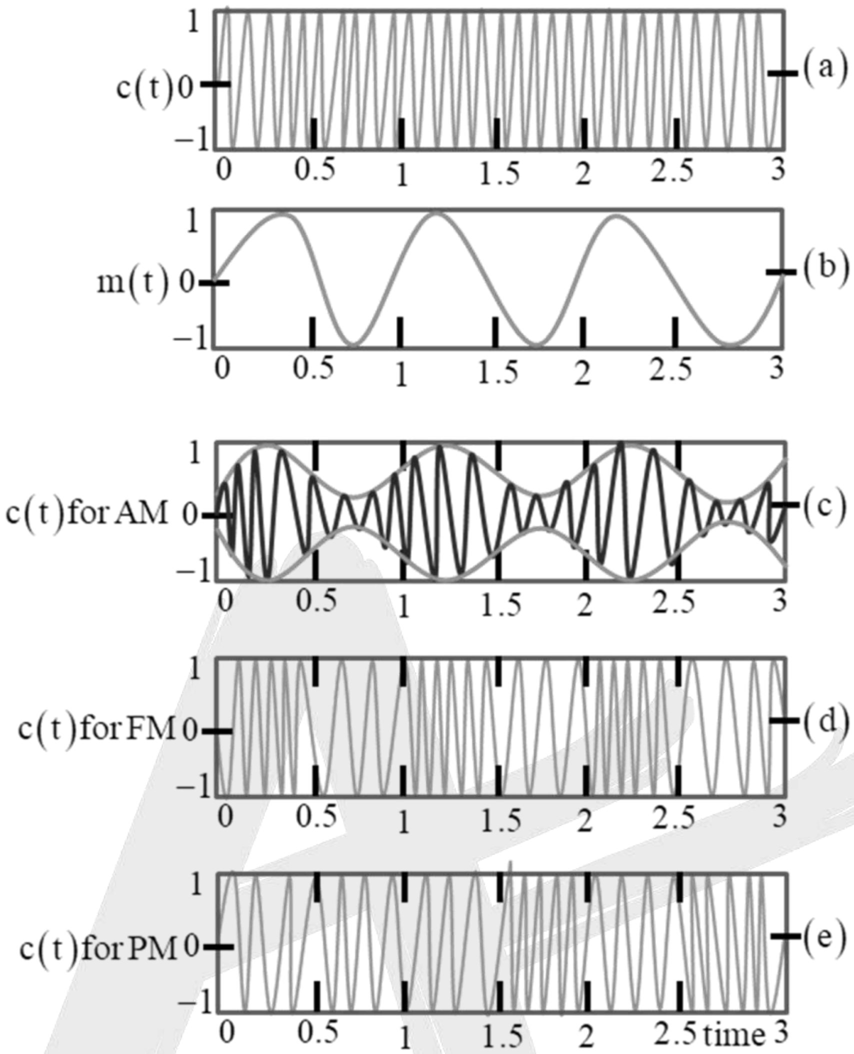
(ii) Angle modulation

Angle modulation again can be of two types. They are

(i) Frequency modulation (FM)

(ii) Phase modulation (PM)

As shown in figure



(II) Pulse Wave Modulation

The significant characteristics of a pulse are:

(i) Pulse amplitude

(ii) Pulse duration or pulse width

(iii) Pulse position (denoting the time of rise or fall of the pulse amplitude) as shown in figure

Types of pulse modulation:

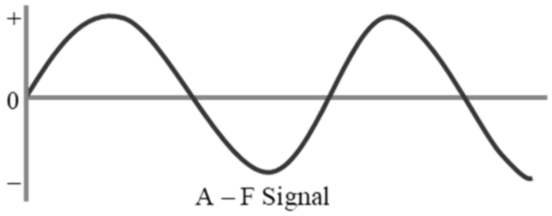
(a) Pulse amplitude modulation (PAM)

(b) Pulse duration modulation (PDM) or pulse width modulation (PWM)

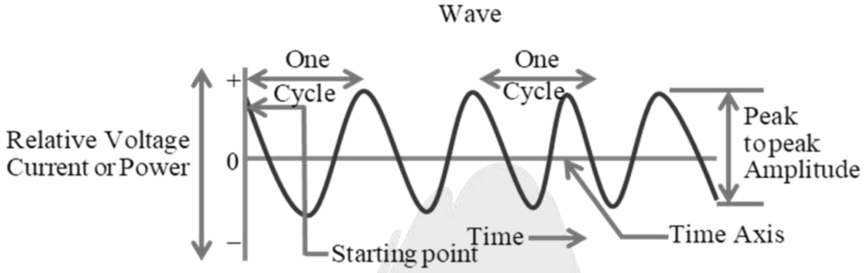
(c) pulse position modulation (PPM)

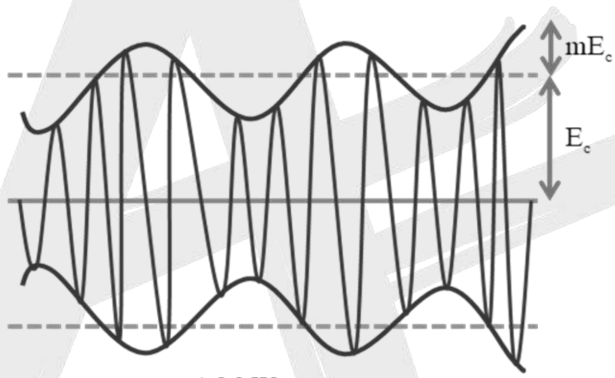
(I) Continuous Wave Modulation:

(1) Amplitude Modulation:



$c(t) = E_c \sin\omega_c t$ represent carrier wave. Here $\omega_c = 2\pi f_c$ is the angular frequency of the carrier signal



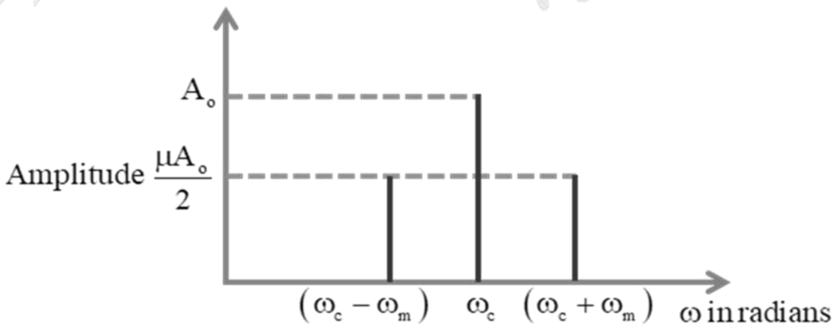


A.M. Wave

$$\frac{E_{max} - E_{min}}{E_{max} + E_{min}} = m_a$$

The Band width of AM wave is "$2f_m$"

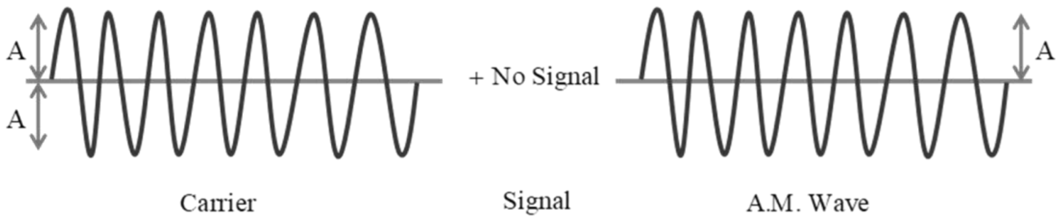
The frequency spectrum of the amplitude modulated signal is shown in



A plot or amplitude versus ω for an amplitude modulated signal

Special cases of Amplitude modultion:

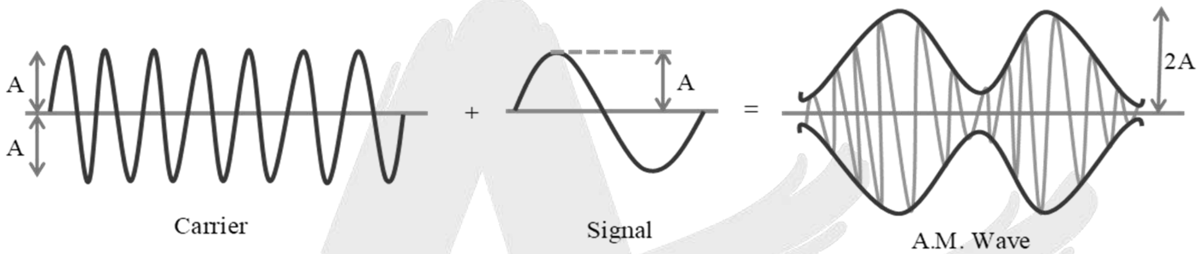
Case - I: In the absence of signal



Modulation factor $m_a = \frac{O}{A} \times 100 = 0\%$

Case –II: When the signal amplitude is equal to CW wave.

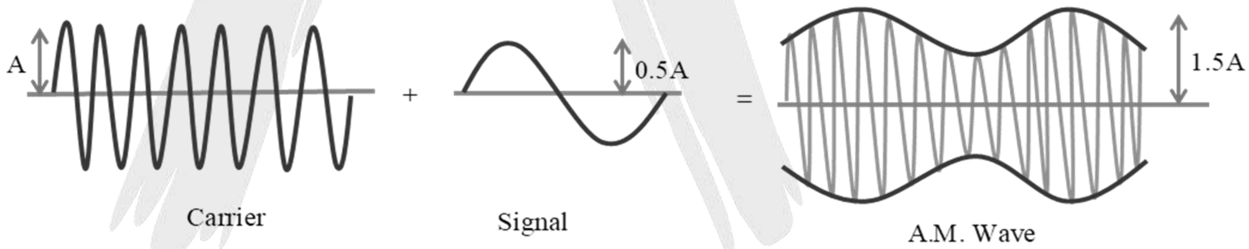
Amplitude varies from 2A to zero.



$$\frac{\text{Amplitude change in carrier wave}}{\text{Amplitude of CW}} = \frac{2A - A}{A} = 100\%$$

Case – III: When the amplitude of the signal is half of that of CW

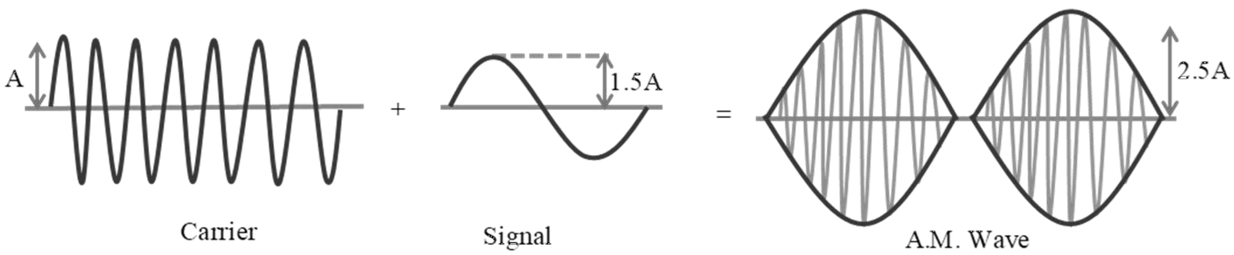
Amplitude of CW changes from A to $\left(A + \frac{A}{2}\right) = 1.5A$



Modulation factor $= \frac{0.5A}{A} = 0.5 = 50\%$

Case – IV: When the amplitude of signal is 1.5 times that of the CW

Amplitude of the modulated wave changes from 2.5A to A

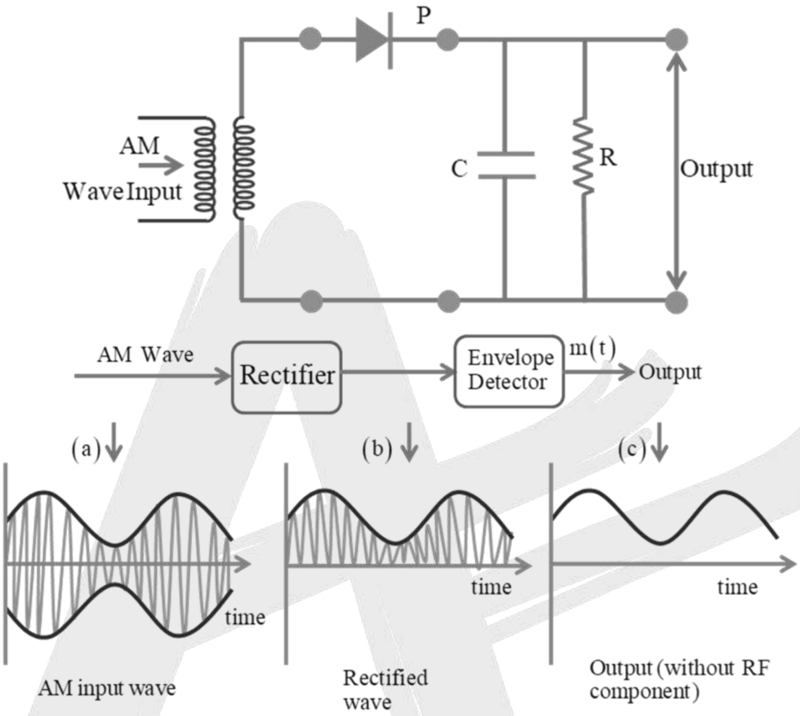


Modulation factor $m_a = \frac{2.5A - A}{A} = 1.5 = 150\%$

In this case the quality of signal is lost

Simple demodulator circuit:

The AM wave input is shown in figure. it appears at the output of the diode across PQ as a rectified wave (since a diode conducts only in the positive half cycle). Instead, it has only the envelope of the modulated wave.

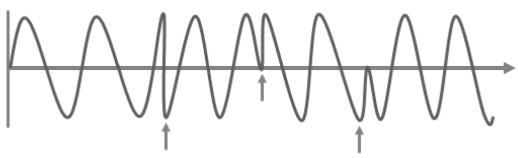


In the actual circuit the value of RC (The time constant, t = RC) is chosen such that $\frac{1}{f_c} << RC$; where f_c = Frequency of carrier signal.

(i) Frequency modulation (FM)

The method in which the frequency of carrier is varied in accordance to the modulating signal, keeping the amplitude and phase of the carrier the same is called Frequency modulation (FM)

(ii) Phase Modulation (PM), phase of carrier is varied in accordance with modulating signal keeping an amplitude and frequency constant. We use the term phase shift to characterize such changes. If phase changes after cycle k, the next sinusoidal wave will start slightly later than the time at which cycle k completes.



(II) Pulse wave modulation.

Here the carrier wave is in the form of pulses.

Pulse modulation is an analog process as the modulating signal is analog.

The common pulse modulating systems are:

EXCERCISE-I

1. A Si and a Ge diode has identical physical dimensions. The band gap in Si is larger than that in Ge. An identical reverse bias is applied across the diodes :

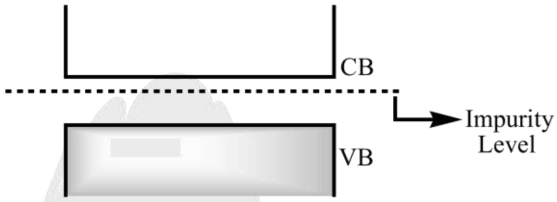
(A) The reverse current in Ge is larger than that in Si

(B) The reverse current in Si is larger than that in Ge

(C) The reverse current is identical in the two diodes

(D) The relative mangitude of the reverse current cannot be determined from the given data only

2. The following band-energy diagram represents :



(A) intrinsic semiconductor
(B) insulator
(C) p-type semiconductor
(D) n-type semiconductor

3. On heating a semiconductor :

(A) mobility decrease, resistivity decreases

(B) mobility decreases, resistivity increases

(C) mobility increases, resistivity increases

(D) mobility increases, resistivity decreases

4. The diffusion current observed in a pn junction is

(A) from n to p side

(B) from p to n side

(C) n to p side if forward biased and p to n if reverse biased

(D) p to n side if forward biased and n to p side if reverse biased

5. In a semiconductor

(A) there are no free electrons at 0 K

(B) there are large number of free electrons at 0 K

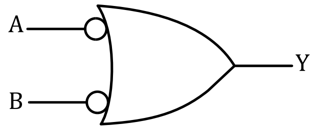
(C) there are large number of free electrons at room temperature

(D) number of free electrons falls with the rise in temperature

6. For a two-stage RC coupled amplifier with voltage gains of 10 and 5 for the first and second stages, respectively, the overall gain is

(A) 15
(B) 5
(C) 75
(D) 50

7. The depicted figure performs the logic function of

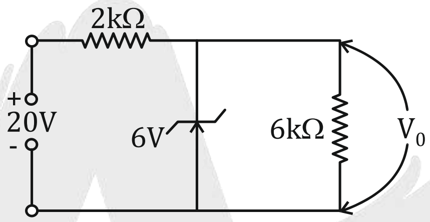


(A) AND gate (B) NOR gate (C) NAND gate (D) XOR gate

8. A transistor amplifier has $h_{FE} = 75; R_L = 5k\Omega$, internal resistance of the base is $2.5k\Omega$ then the voltage gain of the CE amplifier is

(A) 75 (B) 37.5 (C) 150 (D) 375

9. If the potential drop across the output is V_0. determine the value of V_0 at any given instant when $R_0 = 6k\Omega$.



(A) 15 V (B) 5 V (C) 6 V (D) 14 V

10. When base current is changed from $30\ \mu A$ to $80\ \mu A$. The collector current changes from 1 mA to 3.5 mA. Find the current gain in CE configuration.

11. The bonding mechanism in a crystal comprising alternating and equally spaced positive and negative ions is

(A) Covalent (B) Metallic (C) Dipolar (D) Ionic

12. The temperature coefficient of resistance of a semiconductor denotes

(A) Is always positive (B) Is always negative

(C) Is zero (D) May be positive or negative or zero

13. The term used to describe the anticipated energy of electrons at absolute zero is known as

(A) Fermi energy (B) Emission energy

(C) Work function (D) Potential energy

14. The reason why metallic solids are consistently opaque is that

(A) Solids effect the incident light

(B) Incident light is readily absorbed by the free electron in a metal

(C) Incident light is scattered by solid molecules

(D) Energy band traps the incident light

15. The binding within this solid leads to a reduction in its electrical conductivity with temperature, while simultaneously reflecting incident light.

(A) Ionic (B) Covalent (C) Metallic (D) Molecular

16. If a small quantity of As is added to silicon, a semiconductor, its electrical conductivity

(A) Decreases (B) Increases

(C) Remains unchanged (D) Becomes zero

17. The electrical circuit used to obtain a smooth DC output from a rectifier circuit is commonly referred to as a

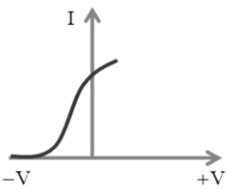
(A) Oscillator (B) Filter (C) Amplifier (D) Logic gates

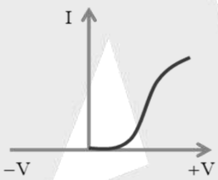
18. Zener breakdown in a semi-conductor diode occurs when

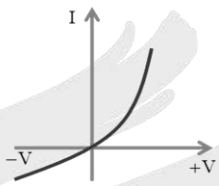
(A) Forward current exceeds certain value (B) Reverse bias exceeds certain value

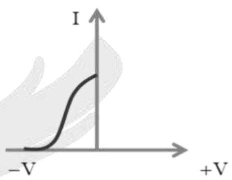
(C) Forward bias exceeds certain value (D) Potential barrier is reduced to zero

19. Different voltages are applied across a P-N junction, and the currents are measured for each value. The graph obtained between voltage and current is represented by which of the following options?

(A) 

(B) 

(C) 

(D) 

20. A diode having potential difference 0.5 V across its junction which does not depend on current, is connected is series with resistance of $20\ \Omega$ across source. If 0.1 A passes through resistance then what is the voltage of the source?

(A) 1.5 V (B) 2.0 V (C) 2.5 V (D) 5 V

21. The maximum distance upto which TV transmission from a TV tower of height h can be received is proportional to $h^{\alpha/\beta}$. Find $\alpha + \beta$?

22. An antenna is of height 125m. what will be its radio horizon (in km) (Radius of the earth is 6400 km)?

23. Which one of the following statements is wrong?

(A) Radio waves in the frequency range 30 MHz to 60 MHz are called sky waves

(B) Radio horizon of the transmitting antenna for space wave is $d_T = \sqrt{(Rh_T)}$

(C) Fiber optical communication is free from electrical disturbances

(D) The principle of fibre optical communication is total internal reflection

24. A radio station has two channels. One is AM at 1020 kHz and the other is FM at 89.5 MHz. For good results you will use

(A) longer antenna for the AM channel and shorter for the FM

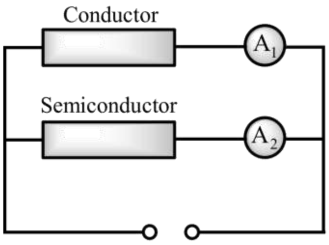
(B) shorter antenna for the AM channel and longer for the FM

(C) Same length antenna with work for both

(D) Information given is not enough to say which one to used for which

EXCERCISE-II

1. A conductor and a semiconductor are connected in parallel as shown in the figure. At a certain voltage both ammeter register the same current. If the voltage of the DC source is increased then the



(A) ammeter connected to the semiconductor will register higher current than the ammeter connected to the conductor

(B) ammeter connected to the conductor will register higher current than the ammeter connected to the semiconductor

(C) ammeters connected to both semiconductor and conductor will register the same current

(D) ammeters connected to both semiconductor and conductor will register no change in the current

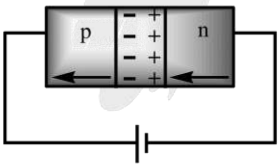
2. The forbidden energy gap in Ge is 0.82 eV. Given, hc = 12400 eV-$\overset{o}{A}$. The maximum wavelength of radiation that will generate and electron hole pair is approximately equal to :

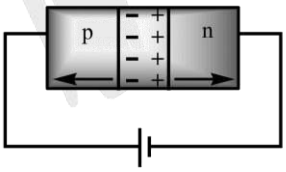
(A) 17222 $\overset{o}{A}$ (B) 1722 $\overset{o}{A}$ (C) 172220 $\overset{o}{A}$ (D) 15121 $\overset{o}{A}$

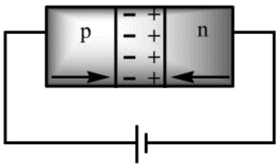
3. In a half wave rectifier if input frequency is 50 Hz then output ripple frequency will be :

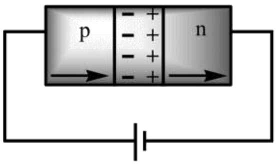
(A) 25 Hz (B) 50 Hz (C) 100 Hz (D) 200 Hz

4. In the case of forward biasing of a p-n junction diode, which one of the following figures correctly depicts the direction of conventional current (indicated by an arrow mark) ?

(A)


(B)


(C)


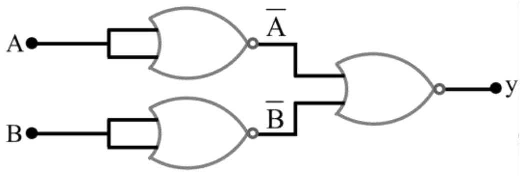
(D)


5. One end of a device is connected to positive terminal and the other end to the negative terminal and the current is flowing. If the terminals of supply are interchanged, then there is approximately zero current. The device can be :

(A) p-n junction (B) transistor

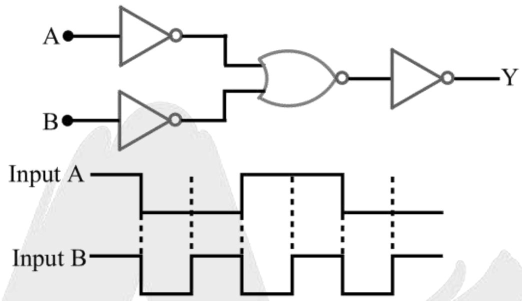
(C) capacitor (D) inductor

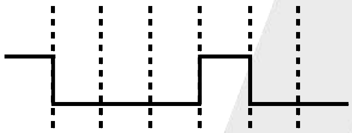
6. Identify the logic operation performed by the circuit given below.

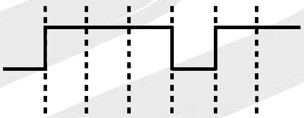


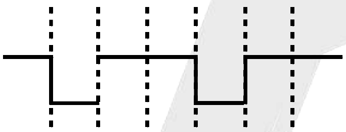
(A) NOT (B) AND (C) NOR (D) NAND

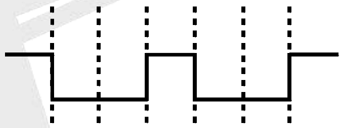
7. The logic circuit shown has the input waveforms 'A' and 'B' as shwon. Pick out the correct output waveform :



(A) 

(B) 

(C) 

(D) 

8. The magnitude of the drift current in a pn junction is smaller than that of the diffusion current. This implies that

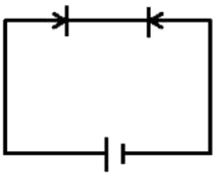
(A) pn junction is forward biased

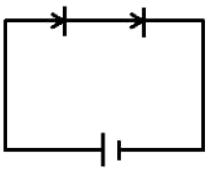
(B) pn junction is reverse biased

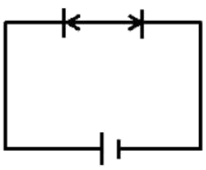
(C) pn junction is unbiased

(D) None of these

9. Which of the following scenarios results in an equal potential drop across the pn junctions?

(A) 

(B) 

(C) 

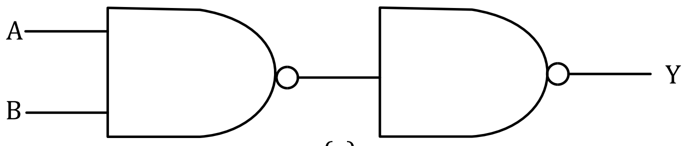
(D) None of these

10. Calcudlate the dynamic resistance of pn junction from the following data in forward bias.

V (volts)	0.2	0.4	0.4	0.6	0.65	0.7
I (mA)	0	0	0.01	0.4	1.1	3.2

(A) 30Ω (B) 24Ω (C) 50Ω (D) None of these

11. The circuit diagram depicted performs the logic function of



(a)

(A) XOR gate (B) AND gate (C) NAND gate (D) OR gate

12. Which type of amplifier is referred to as a current amplifier?

(A) CE (B) CB (C) CC (D) A and C

13. Which type of amplifier provides a phase shift of 180° between the input and output signals?

(A) CB (B) CC (C) CE (D) None of these

14. Which configuration is most suitable for designing an oscillator?

(A) CB (B) CC (C) CE (D) None of these

15. How many gates are needed to design the logic function $P = X + \overline{X}Y$?

Also name the gates.

(A) 1, OR (B) 2, AND and OR

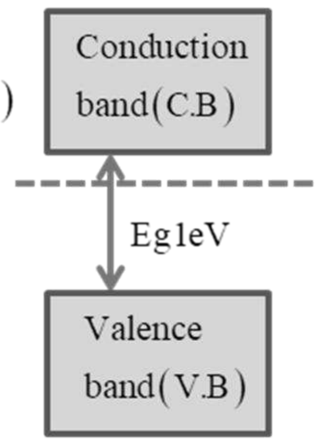
(C) 3, AND, NOT and OR (D) None of these

16. In a pure semiconductor with equal electron and hole concentrations of $10^{16}\,m^{-3}$, the doping process with indium increases the electron concentration n_k to $4.5\times10^{22}\,m^{-3}$. What is n_e in the doped semiconductor?

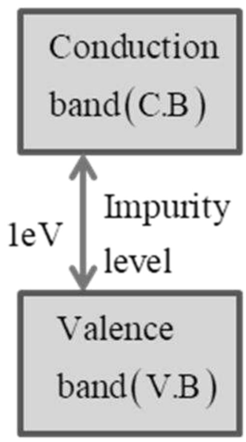
(A) $10^{6}\,m^{-3}$ (B) $10^{22}\,m^{-3}$ (C) $\frac{10^{32}}{4.5\times10^{22}}\,m^{-3}$ (D) $4.5\times10^{22}\,m^{-3}$

17. Which of the following energy band diagrams represents an N-type semiconductor?

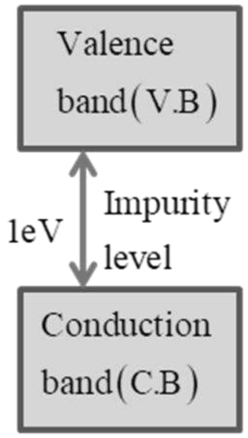
(A)



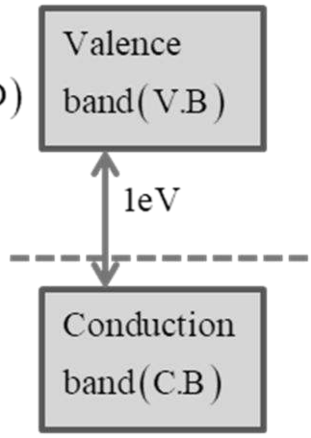
(B)



(C)



(D)



18. If a potential barrier of 0.50 V exists across a P-N junction and the depletion region is 5.0×10^{-7}m wide, the intensity of the electric field in this region is

(A) 1.0×10^{6}V/m (B) 1.0×10^{5}V/m (C) 2.0×10^{5}V/m (D) 2.0×10^{6}V/m

19. A TV tower has a height of 100m. how much population is covered by TV broadcast, if the average population density around the tower is $1000 / km^2$?

(A) 39.5×10^{5} (B) 19.5×10^{6} (C) 29.5×10^{7} (D) 9×10^{4}

20. If the area to be covered for TV telecast is doubled,then the height of transmitting antenna (TV tower) will have to be

(A) doubled (B) halved (C) quadrupled (D) kept unchanged

21. Government has divided the frequency range from 30 MHz to 60 MHz between 20 stations which are independently beaming their signals. Which of the signals can be beamed by each of the stations?

(A) Voice signals only

(B) Music signals and voice signals only

(C) TV signals, music signals as well as voice signals

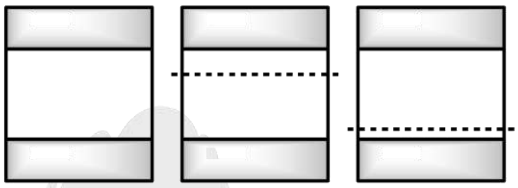
(D) None of the above

22. In an FM system a 7 kHz signal modulates 108 MHz carrier so that frequency deviation is 50 kHz. Modulation index is $\frac{7143}{n}$. Find n?

EXCERCISE-III

1. A semiconductor Germanium (Ge-As) has an energy gap of 1.43 eV. The maximum wavelength (in $\overset{o}{A}$) emitted when a hole and an electron recombine in such semiconductor, is :

2. The energy band diagram for three semiconductor samples of silicon are as shown. We can then assert that :



(A) sample X is undoped while samples Y and Z have been doped with a trivalent and a pentavalent impurity respectively

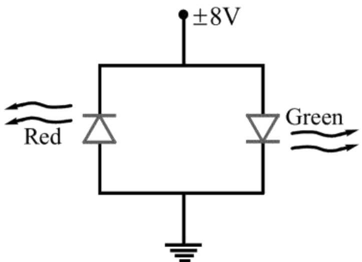
(B) sample X is undoped while both samples Y and Z have been doped with a pentavalent impurity

(C) sample X has been doped with equal amounts of trivalent and pentavalent impurities while samples Y and Z are undoped

(D) sample X is undoped while samples Y and Z have been doped with a pentavalent and a trivalent impurity respectively

3. The mobility of electrons and holes in a sample of instrinsic germanum at room temperature are 0.36 and $0.14 m^2$ /V-s. If electron and holes densities each are equal to $2.5 \times 10^{19} / m^3$ then conductivity of germanium will be (in ohm meter) :

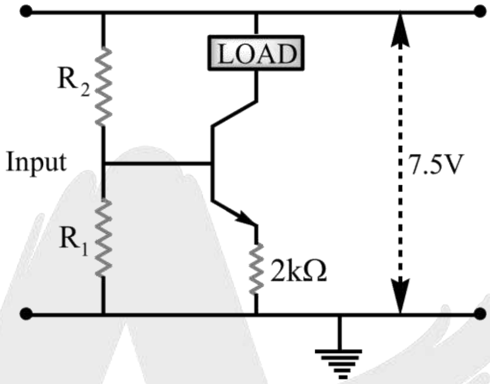
4. If the figure shown are 2 LED's that can be used as a polarity detector. Apply a positive source voltage and a green light results. Negative supplies result in a red light. Packages of such combination are commercially available. Find resistor R (in Ω) to ensure a current of 20 mA through the ON diode for the configuration. Both diodes have reverse breakdown voltage of 3 V and average turn on voltage of 2 V.



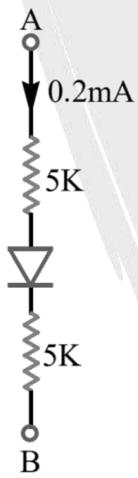
5. Which of the following is not a transducer?

(A) Loudspeaker (B) Amplifier (C) Microphone (D) Thermometer

6. In the transistor circuit shown, assume that the voltage drop between the base and emitter is 0.5 V. What will be the ratio of the voltage across resistances R_2 and R_1 in order to make this circuit function as a source of constant current, I = 1 mA?

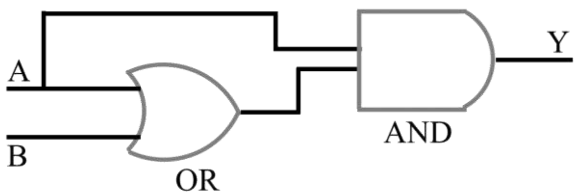


7. In the circuit shown in figure, if the diode forward voltage drop is 0.3 V, the voltage difference between A and B is :



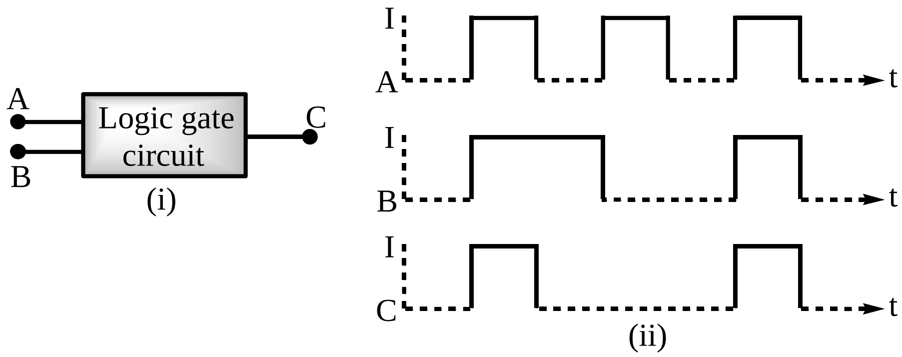
(A) 1.3 V (B) 2.3 V (C) 0 (D) 0.5 V

8. The output Y of the combination of gates shown is equal to :



(A) A (B) $\bar{A}$ (C) $A+B$ (D) $\overline{AB}$

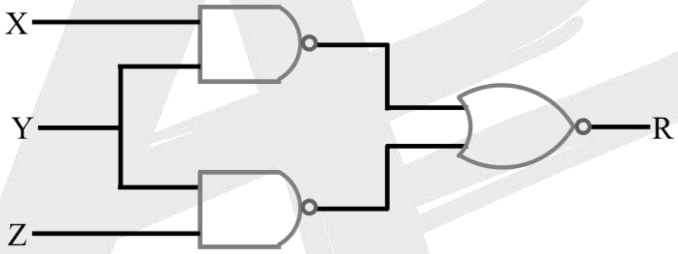
9. The following figure (i) shows a logic gate circuit with two inputs A and B and output C. The voltage waveforms of A, B and C are as shown in figure (ii) given below :



The logic circuit gate is :

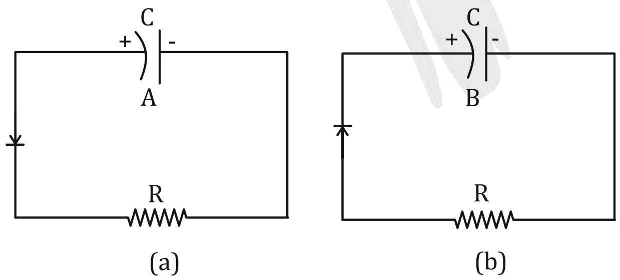
(A) OR gate (B) AND gate (C) NAND gate (D) NOR gate

10. Figure shows 2 NAND gates followed by a NOR gate. The system is equivalent to one gate G with inputs X, Y, Z and output R. What is G?



(A) OR (B) NAND (C) XOR (D) AND

11. At time t = 0, two identical capacitors A and B are charged to the same potential V and connected in circuits (A) and (B) as depicted. After a time t = CR, the charges on capacitors A and B are respectively.

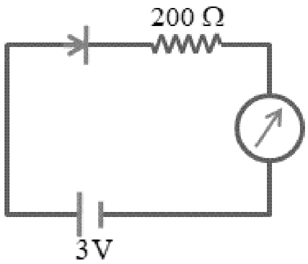


(A) CV, CV (B) $CV, \frac{CV}{e}$ (C) $\frac{CV}{e}, CV$ (D) $\frac{CV}{e}, \frac{CV}{e}$

12. Two - gates can be utilized to create an AND gate.is

(A) NOT (B) NOR (C) XOR (D) NAND

13. If the diode is not ideal, the reading on the ammeter in the depicted circuit would be...

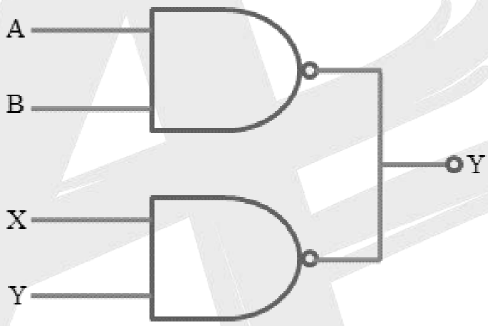


(A) 0 (B) 15 mA (C) > 15 mA (D) < 15 mA

14. Determine the binary equivalent of the decimal number 75.

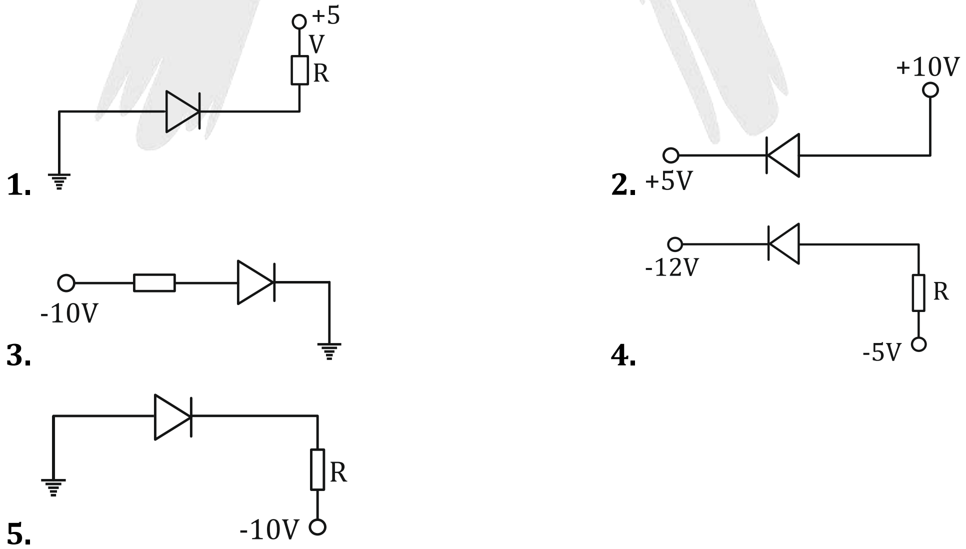
(A) 1001011 (B) 101001 (C) 1100001 (D) 1001111

15. Figure represents ----------- gate



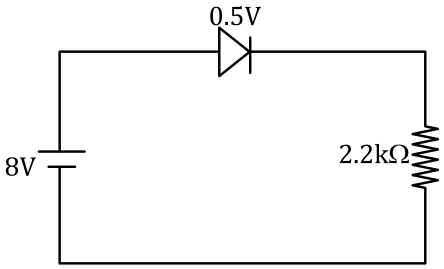
(A) Phantom OR (B) NAND (C) NOR (D) XOR

16. In the provided figure, which of the diodes are in a forward-biased state?



(A) 1, 2, 3 (B) 2, 4, 5 (C) 1, 3, 4 (D) 2, 3, 4

17. In the circuit, if the forward voltage drop for the diode is 0.5 V, the current will be



(A) 3.4 mA (B) 2 mA (C) 2.5 mA (D) 3 mA

18. The total maximum transmitted power in amplitude modulation if the carrier output power is 1 kW is $\frac{15}{n}$ kW. Find n?

19. Advantage of optical fibre is

(A) high bandwidth and EM interference

(B) low bandwidth and EM interference

(C) high bandwidth, low data transmission capacity and no EM interference

(D) high bandwidth, high data transmission capacity and no EM interference

20. Which of the following statements is Wrong?

(A) Ground wave propagation can be sustained at frequencies 500 kHz to 1500 kHz

(B) Satellite communication is useful for the frequencies above 30 MHz

(C) Sky wave propagation is useful in the range of 30 to 40 MHz

(D) The phenomenon involved in sky wave propagation is total internal reflection

21. If the unmodulated level peak carrier amplitude is double of modulating signal in an AM signal, the amplitude modulation is

(A) 20% (B) 50% (C) 100% (D) 200%

22. Consider telecommunication through optical fibres. Which of the following statements is not true?

(A) Optical fibres can be of graded refractive index

(B) Optical fibres are subjected to electromagnetic interference from outside

(C) Optical fibres have extremely low transmission loss

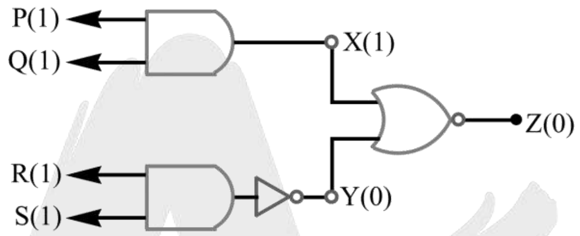
(D) Optical fibres may have homogeneous core with a suitable cladding

EXCERCISE-IV

1. Current gains in common base configuration of a transistor is 0.95. What should be the change in collector-current corresponding to a change of 0.4 mA in the base-current in common-emitter configuration :

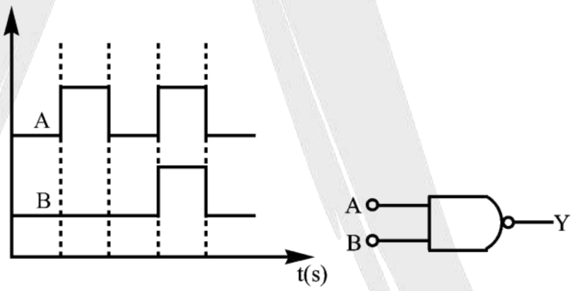
(A) 2.6 mA (B) 4.9 mA (C) 8.2 mA (D) 7.6 mA

2. The circuit diagram shows a logic combination with the states of output X, Y and Z given for inputs P, Q, R and S all at state 1. When inputs P and R change to state 0 with inputs Q and S still at 1, the states of outputs X, Y and Z change to :

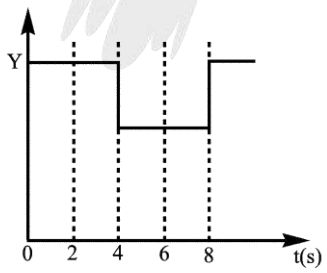


(A) 1, 0, 0 (B) 1, 1, 1 (C) 0, 1, 0 (D) 1, 1, 0

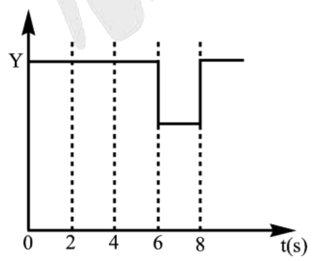
3. The real time variation of input signals A and B are as shown below. If the inputs are fed into NAND gate, then select the output signal from the following :



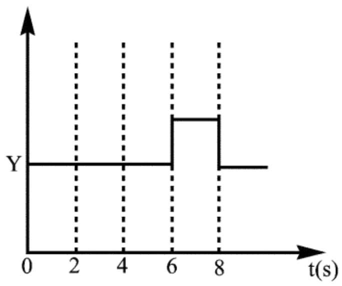
(A)



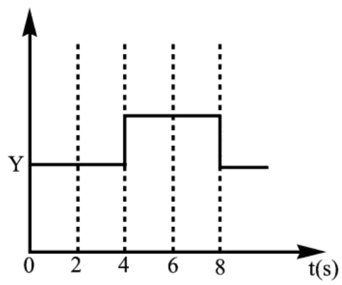
(B)



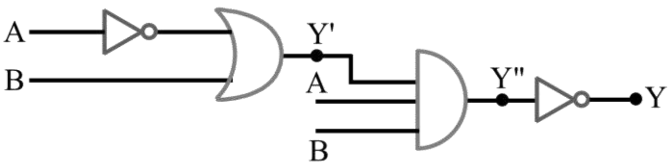
(C)



(D)

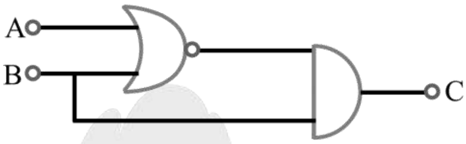


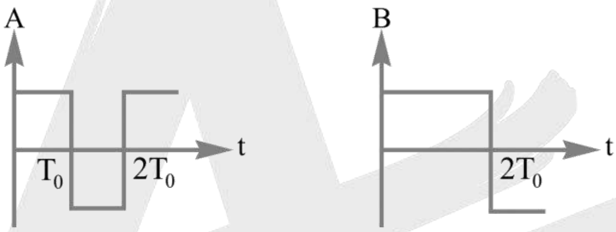
4. Circuit given below is that of :

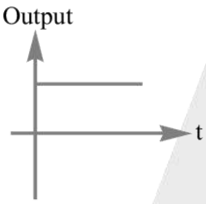


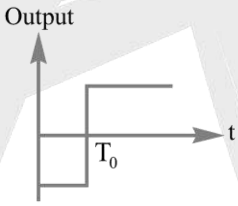
(A) AND gate (B) OR gate (C) NAND gate (D) ex-NOR gate

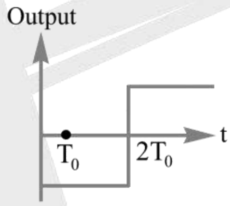
5. Correct output for given logic circuit and inputs is :

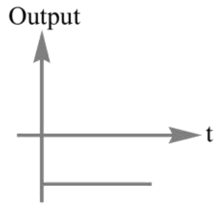




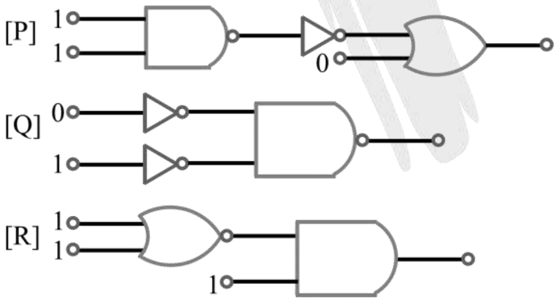
(A) 

(B) 

(C) 

(D) 

6. In the following combination of logic gates, the outputs of A, B and C are respectively :



(A) 0, 1, 0 (B) 1, 1, 0 (C) 1, 0, 1 (D) 0, 1, 1

7. At what temperature would an electron transition from the valence band to the conduction band if $E_g = 0.23 eV$?

(A) 230 K (B) 326 K

(C) 3260 K (D) 2670 K

8. In a photodiode, the conductivity exhibits an increase when light with a wavelength less than 620 nm is incident. The bandgap is

(A) 1.12 eV (B) 1.8 eV (C) 2.0 eV (D) 1.62 eV

9. A load resistor of 2kΩ is connected in the collector branch of an amplifier using CE mode. $\beta = 50$ and input resistance of the transistor = 500Ω. If the input current is changed by 50μA then by what amount does the output voltage change? (In Volts)

10. Energy bands in solids are a consequence of

(A) Ohm's Law (B) Pauli's exclusive principle

(C) Bohr's theory (D) Heisenberg's uncertainity principle

11. In a germanium (Ge) specimen doped with aluminum (Al), with a concentration of acceptor atoms is $\sim 10^{21}$atoms/m^3. and given the intrinsic concentration of electron-hole pairs is $\sim 10^{19}$/m^3, the concentration of electrons in the specimen is .

(A) n_e increases and v_d decrases

(B) n_e decreases and v_d increases

(C) Both n_e and v_d increase

(D) Both n_e and v_d decrease

12. The energy gap of silicon is 1.14 eV. The maximum wavelength at which silicon will begin absorbing energy is

(A) $10888\,\overset{o}{A}$ (B) $1088.8\,\overset{o}{A}$ (C) $108.88\,\overset{o}{A}$ (D) $10.888\,\overset{o}{A}$

13. A Ge specimen is doped with Al. The concentration of acceptor atoms is $\sim 10^{21}\text{atoms}/\text{m}^3$. Given that the intrinsic concentration of electron hole pairs is $\sim 10^{19}/\text{m}^3$, the concentration of electrons in the specimen is

(A) $10^{17}/\text{m}^3$ (B) $10^{15}/\text{m}^3$ (C) $10^4/\text{m}^3$ (D) $10^2/\text{m}^3$

14. The electron mobility in N – type germanium is $3900\,\text{cm}^2/\text{v}-\text{s}$ and its conductivity is 6.24 mho/cm, then impurity concentration will be if the effect of cotters is negligible

(A) 10^{15}cm^3 (B) $10^{13}/\text{cm}^3$ (C) $10^{12}/\text{cm}^3$ (D) $10^{16}/\text{cm}^3$

15. A silicon specimen is converted into a P-type semiconductor by doping, with an average of one indium atom per 5×10^7 silicon atoms. If the number density of atoms in the silicon specimen is $5\times10^{28}\text{atoms}/\text{m}^3$, the number of acceptor atoms in silicon per cubic centimeter will be

(A) $2.5\times10^{30}\text{atoms}/\text{cm}^3$ (B) $1.0\times10^{13}\text{atoms}/\text{cm}^3$

(C) $1.0\times10^{15}\text{atoms}/\text{cm}^3$ (D) $2.5\times10^{36}\text{atoms}/\text{cm}^3$

16. When a PN junction diode is forward biased, energy is released at the junction due to the recombination of electrons and holes. This energy is typically in the form of

(A) Visible region (B) Infrared region (C) UV region (D) X-ray region

17. In a PN-junction diode not connected to any circuit

(A) The potential is the same everywhere

(B) The P-type is a higher potential than the N-type side

(C) There is an electric field at the junction directed from the N-type side to the P-type side

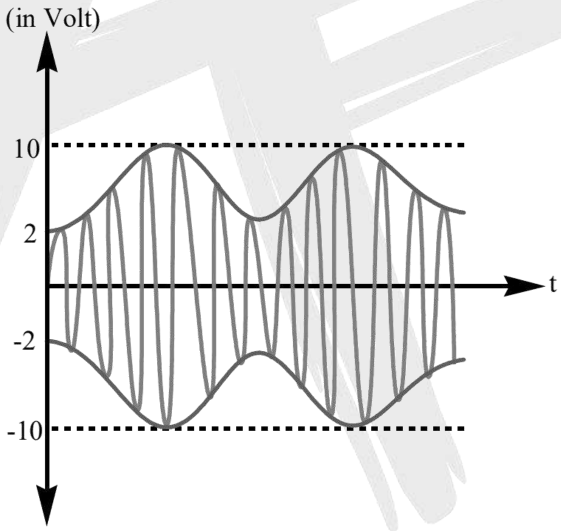
(D) There is an electric field at the junction directed from the P-type side to the N-type side

18. The peak voltage in the output of a half-wave diode rectifier fed with a sinusoidal signal without filter is 10 V. The de component of the output voltage is

(A) $10/\sqrt{2}\,V$ (B) $10/\pi\,V$ (C) 10 V (D) $20/\pi\,V$

19. A diode AM detector with the output circuit consisting of $R = 1k\Omega$ and $C = 1\mu F$ would be more suitable for detecting a carrier signal (in kHz) of

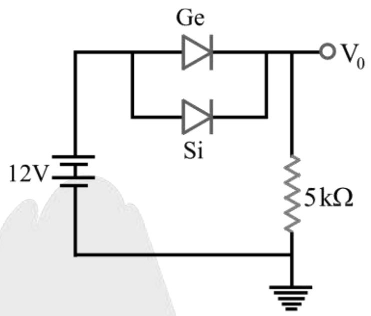
20. Figure shows the waveform of an amplitude modulated wave. Its modulation factor is $\frac{2}{\alpha}$. Find α ?



EXCERCISE-V

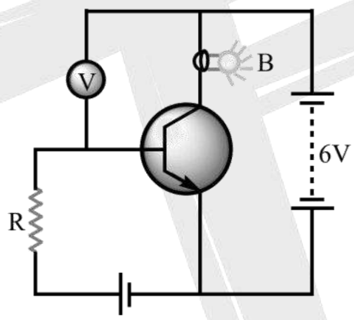
1. In a common emitter transitor amplifier, an input signal of 50 mV is applied. Due to this signal, the change in base current is $50\ \mu A$ and the corresponding change in collector current in 5 mA. If the load resistance in the collector emitter circuit is $5\ k\Omega$, the change in output voltage (in V) will be :

2. Ge and Si diodes conduct at 0.3 V and 0.7 V respectively. In the following figure if Ge diode connection is reversed the value of V_0 change by :



(A) 0.2 V (B) 0.4 V (C) 0.6 V (D) 0.8 V

3. In the given circuit, a voltmeter 'V' is connected across a bulb 'B'. If the resistor 'R' is increased in value :



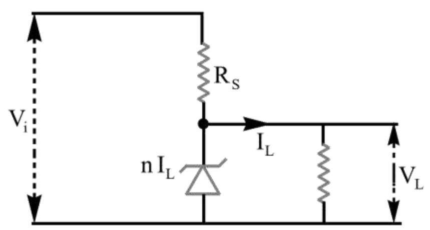
(A) The voltmeter shows a lower voltage

(B) The voltmeter shows a higher voltage

(C) The voltmeter shows a same voltage

(D) The glow of bulb will increase

4. The value of the resistor, R_S, needed in the dc voltage regulator circuit shown here, equals :

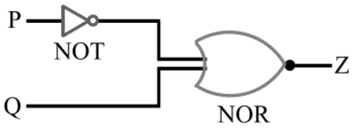


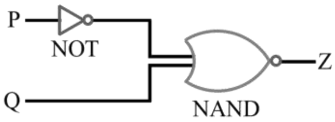
(A) $\frac{(V_i - V_L)}{2nI_L}$ (B) $\frac{(V_i + V_I)}{nI_L}$ (C) $\frac{(V_i + V_L)}{(n+1)I_L}$ (D) $\frac{(V_i - V_L)}{(n+1)I_L}$

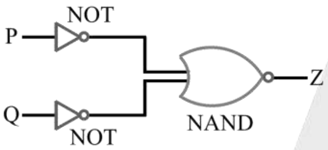
5. A combination of logic gates has the truth table below :

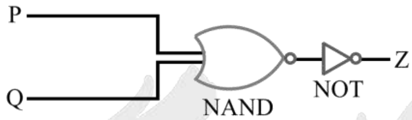
P	Q	Z
0	0	0
0	1	1
1	0	1
1	1	1

Which of the following combinations has this truth table ?

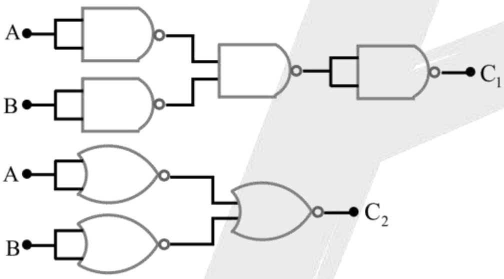
(A)


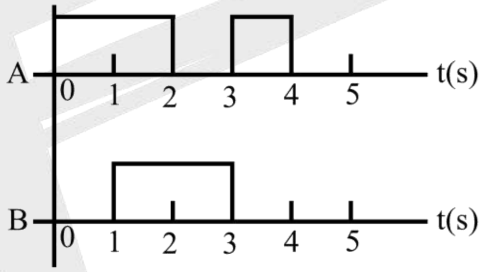
(B)


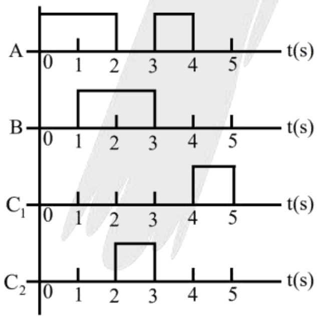
(C)


(D)


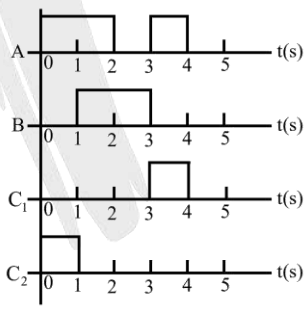
6. Draw the output signals C_1 and C_2 in the given combiation of gates. (Upto 5 sec)



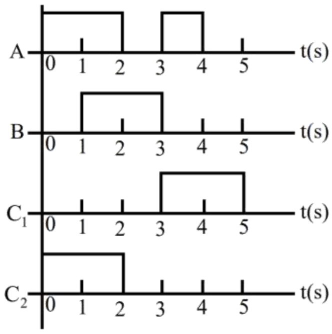




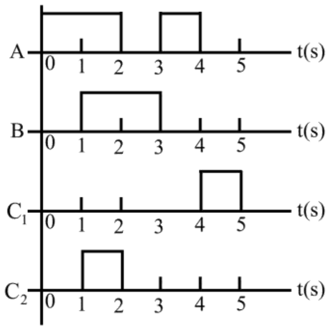
(A)



(B)



(C)

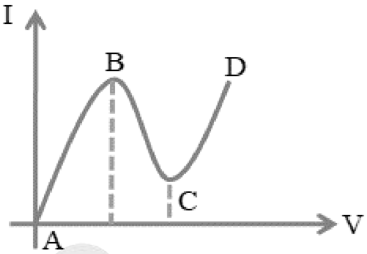


(D)

7. If $I = 0.1(\text{mA})\left[e^{V/V}T - 1\right]$ is valid for a pn junction. Then find the resistance when V = 0.5 volt and $V_T = 0.025$ volt.

(A) 50Ω (B) 25Ω (C) 10Ω (D) Zero

8. Which region in the provided figure represents negative resistance?

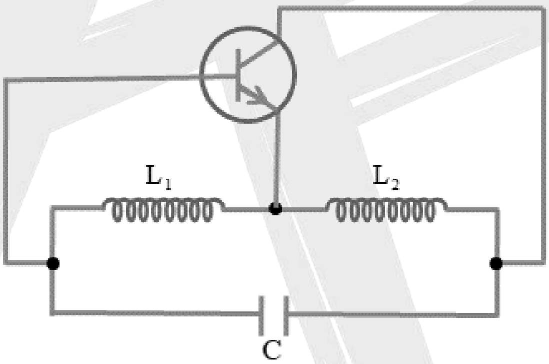


(A) AB (B) BC (C) CD (D) None of these

9. For the given expression P = X + XY, how many gates are necessary for its implementation?

(A) 2 (B) 3 (C) 1 (D) None

10. The figure represents an AC equivalent circuit of a Hartley oscillator. The frequency of oscillation in this circuit is



(A) $f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{(L_1 + L_2)C}}$ (B) $f_0 = \frac{1}{2\pi\sqrt{(L_1 - L_2)C}}$

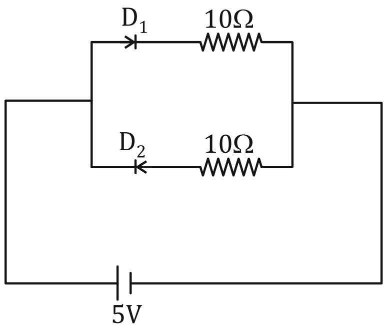
(C) $f_0 = \frac{1}{2\pi\sqrt{L_1 L_2 C}}$ (D) $f_0 = \frac{1}{2\pi\sqrt{\frac{(L_1 + L_2)C}{2}}}$

11. In a pn junction, there is a potential barrier of 250 meV across the junction. A hole with a kinetic energy (KE) of 300 meV approaches the junction. Determine the KE of the hole when it crosses the junction (i) from the p-side to the n-side and (ii) from the n-side to the p-side.

(A) 50 meV, 50 meV (B) 550 meV, 50 meV

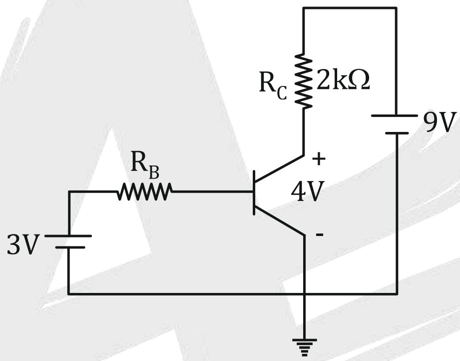
(C) 50 meV, 550 meV (D) 550 meV, 550 meV

12. If the diodes are ideal, the current through the circuit is



(A) 1 A (B) 0.5 A (C) > 0.5 A (D) > 1.0 A

13. Determine the value of the base resistance R_B (in $k\Omega$) in the given circuit below, given that $h_{FE} = 90$.



14. In the middle of the depletion layer of a reverse – biased PN junction, the

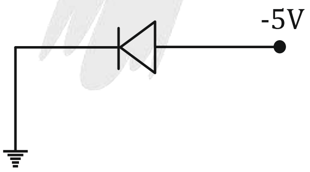
(A) Potential is zero

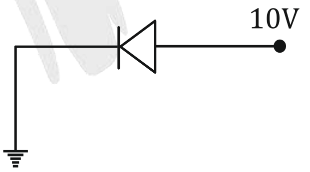
(B) Electric field is zero

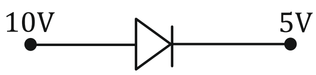
(C) Potential is maximum

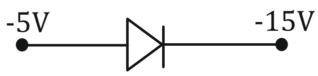
(D) Electric field is maximum

15. Which of the following semiconductor diodes is in a reverse-biased state?

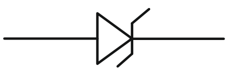
(A) 

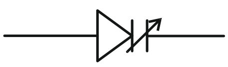
(B) 

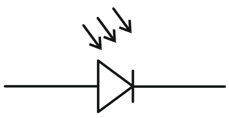
(C) 

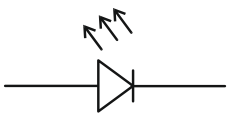
(D) 

16. Symbolic representation of photodiode is

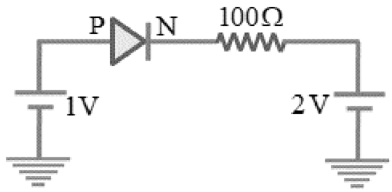
(A) 

(B) 

(C) 

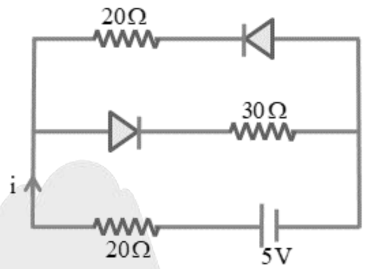
(D) 

17. The current through an ideal PN-junction in the given circuit diagram will be



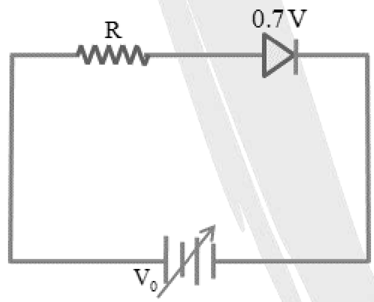
(A) Zero (B) 1 mA (C) 10 mA (D) 30 mA

18. Current in the circuit will be



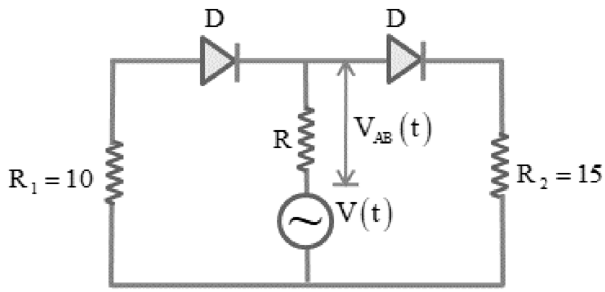
(A) $\frac{5}{40}$ A (B) $\frac{5}{50}$ A (C) $\frac{5}{10}$ A (D) $\frac{5}{20}$ A

19. The junction diode in the given circuit necessitates a minimum current of 1 mA to be above the knee point (0.7 V) of its 1-V characteristic curve. Above the knee point, the voltage across the diode remains constant and independent of the current. If $V_B = 5V$, then determine the maximum value of R that ensures the voltage remains above the knee point.



(A) 4.3 kΩ (B) 860 kΩ (C) 4.3 Ω (D) 860 Ω

20. In the provided circuit diagram below, where V(t) represents the sinusoidal voltage source, the voltage drop $V_{AB}(t)$ across the resistance R is



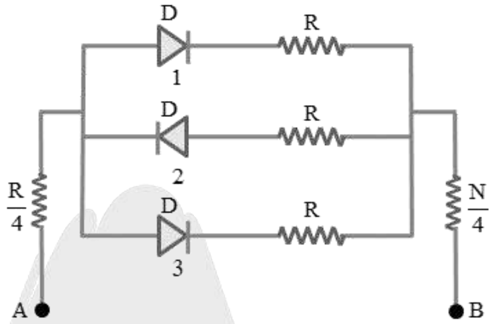
(A) Is half wave rectified

(B) Is full wave rectified

(C) Has the same peak value in the positive and negative half cycles

(D) Has different peak values during positive and negative half cycle

21. In the following circuits PN-junction diodes D_1, D_2 and D_3 are ideal for the following potential of A and B, the correct increasing order of resistance between A and B will be



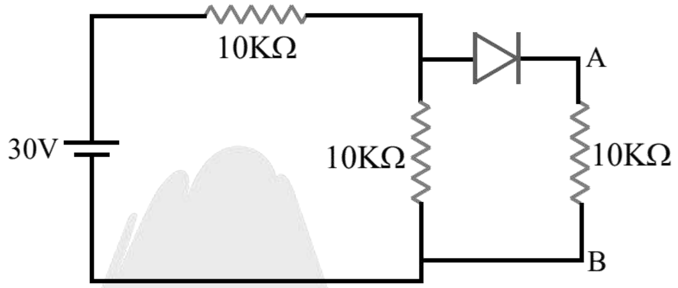
(i) $-10\text{V}, -5\text{V}$ (ii) $-5\text{V}, -10\text{V}$ (iii) $-4\text{V}, -12\text{V}$

(A) $(i)<(ii)<(iii)$ (B) $(iii)<(ii)<(i)$ (C) $(ii)=(iii)<(i)$ (D) $(i)=(iii)<(ii)$

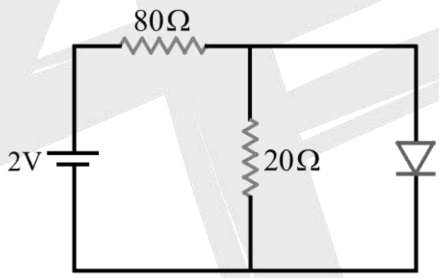
PROFICIENCY TEST-I

1. A silicon specimen is made into a p-type semiconductor by doping, on an average, one indium atom per 5×10^{7} silicon atoms. If the number density of atoms in the silicon specimen is 5×10^{28} atom m^{-3}, then the number of acceptor atoms in silicon per cubic centimeter is $\alpha\times10^{\beta}$ atom cm^{-3}. Find $\alpha+\beta$?

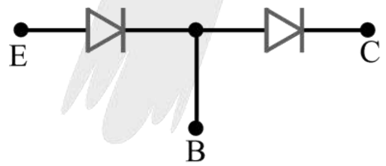
2. In the given figure potential difference between A and B (in V) is : (Assume ideal diode)



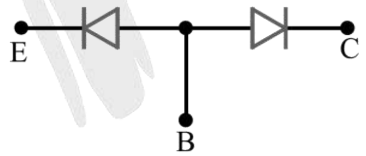
3. In the circuit shown, the current through the ideal diode is $\frac{2}{n}$ A. Find n ?



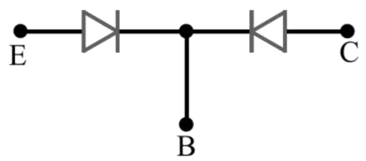
4. If n-p-n transistor is to be considered to be equivalent to two diodes connected (according to biasing only). Which of the following figures is the correct one?



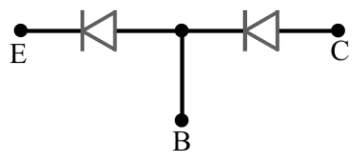
(A)



(B)



(C)



(D)

5. For half wave rectifier if load resistance R_L is $2k\Omega$ and p-n junction resistance R_d is $2k\Omega$. Determine rectification efficiency.

(A) 40.6% (B) 20.3%

(C) 41.2% (D) 81.2%

6. Identify the true statement of OR gate :

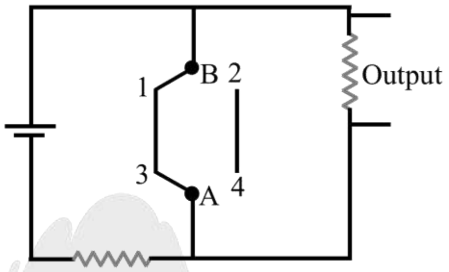
(A) Output Y will be 1 when the input A or B or both are 1

(B) Output Y will be 0 when either of the inputs A and B is 1

(C) Output Y will be 1 only when both the inputs A and B are 1

(D) Output Y will be 1 only when either of the inputs A and B is 1

7. Switch B can rest at either 1 or 2 as well as switch A can rest at either 3 or 4 then output will be:



(A) $A\cdot\overline{B}$ (B) $\overline{A\cdot B+\overline{A}\cdot\overline{B}}$ (C) $A\cdot\overline{B}+B\cdot\overline{A}$ (D) $\overline{A+B}$

8. In a pure semiconductor the number of condution electrons is $6\times10^{9}/m^{3}$. The number of holes in a sample of 1 cm × 1 cm × 1 mm are

(A) 6×10^{13} (B) 6×10^{12} (C) 6×10^{15} (D) 6×10^{16}

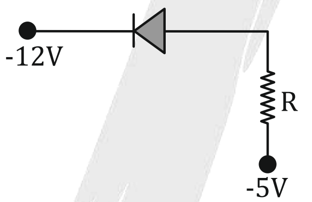
9. Semiconductors can be damaged by the presence of high currents caused by

(A) Lack of free electron (B) Excess of electrons

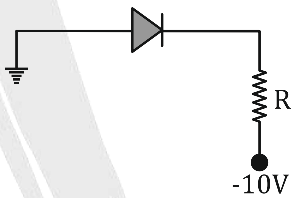
(C) Excess of proton (D) None of these

10. Among the diodes depicted in the following diagrams, which one is in a reverse-biased state?

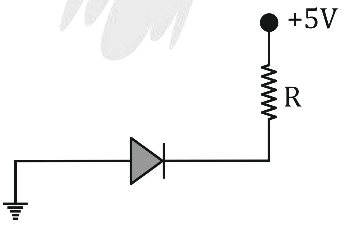
(A)



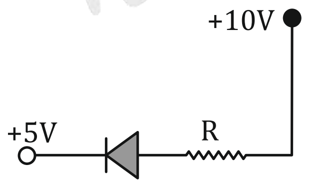
(B)



(C)



(D)



11. Which one of the following is incorrect statement in the transmission of electromagnetic waves?

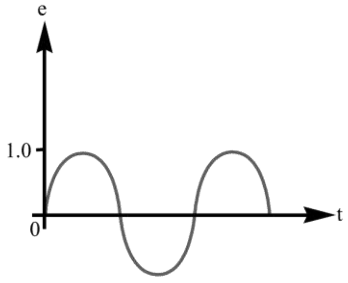
(A) Ground wave propagation is for high frequency transmission

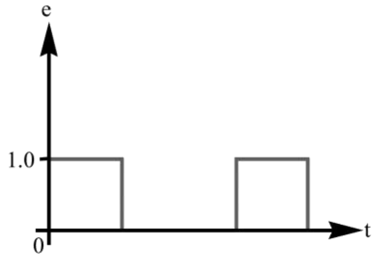
(B) Sky wave propagation is faciliated by ionospheric layers

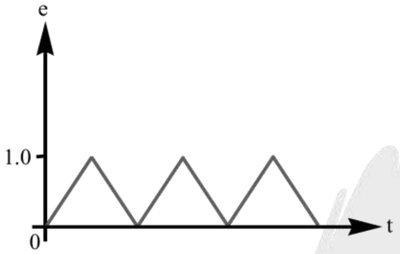
(C) Space wave is used for satellite communication

(D) Very high frequency waves cannot be reflected by the ionospheric layers

12. The time variation of signals are given as in A, B and C. point out the true statement from the following.

(P)


(Q)


(R)


(A) P, Q and R are analogue signals

(B) P and R are digital, but Q is analogue signal

(C) P and R are analogue but Q is digital signal

(D) P, Q and R are digital signal

13. In AM transmission, bandwidth of transmission is 10 kHz and carrier frequency is 100 kHz, then side band frequencies are given by

(A) 90 kHz, 110 kHz

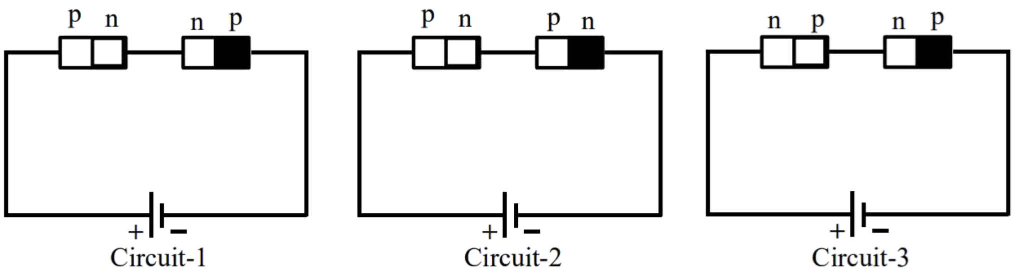
(B) 95 kHz, 105 kHz

(C) 100 kHz, 110 kHz

(D) 90 kHz, 100 kHz

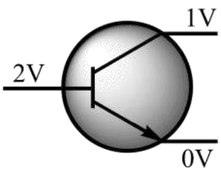
PROFICIENCY TEST-II

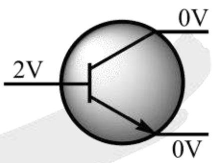
1. Two identical p-n junctions may be connected in series with a battery in three distinct modes as shwon in figure. The potential drops across each of the two p-n junctions are equal corresponding to:

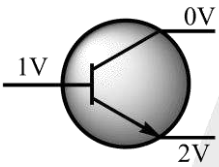


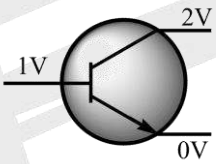
(A) Circuit 2 only (B) Circuit 1 and 2 (C) Circuit 2 and 3 (D) Circuit 3 only

2. In which of the following cases, the transistor is operating in the active region?

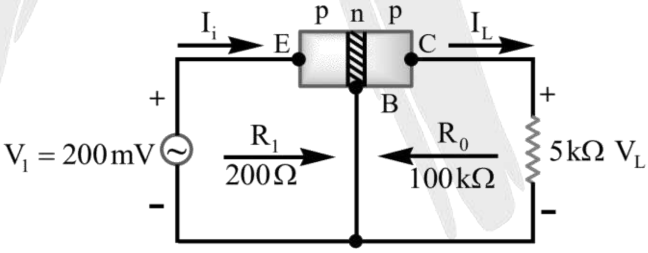
(A) 

(B) 

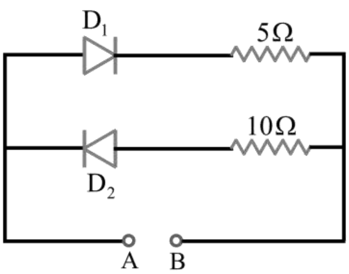
(C) 

(D) 

3. In the following transisitor circuit R_i is the input resistance, R_0 is the output resistance. The approximate voltage gain for the circuit is :

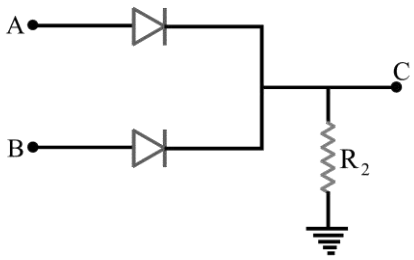


4. A 2V battery is connected across AB as shown in the figure. The value of the centre supplied by the battery when in one case battery's positive terminal is connected to A and in other case when positive terminal of battery is connected to B will respectively be :



(A) 0.1 A and 0.2 A (B) 0.4 A and 0.2 A (C) 0.2 A and 0.4 A (D) 0.2 A and 0.1 A

5. In the adjacent circuit, A and B represent two inputs and C represents the output. The circuit represents :



(A) NOR gate (B) NAD gate (C) NAND gate (D) OR gate

6. In the middle of the deplection layer of a reverse biased pn junction the

(A) potential is maximum (B) electric field is maximum

(C) potential is zero (D) electric field is zero

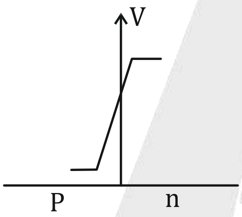
7. If $I_C = 4\text{mA}$ and $\beta = 45$. Then I_E is

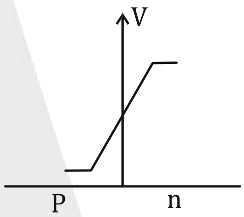
(A) 4.1 mA (B) 4.02 mA (C) 4.4 mA (D) 4.04 mA

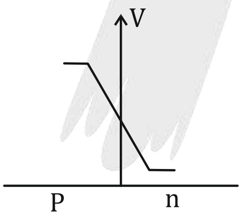
8. The approximate ratio of resistance in the forward and reverse bias of the PN-junction diode is

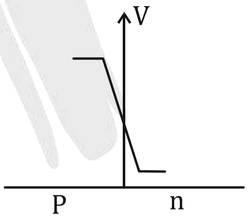
(A) $10^2 : 1$ (B) $10^{-2} : 1$ (C) $1 : 10^{-4}$ (D) $1 : 10^4$

9. In a forward biased PN-junction diode, the potential barrier in the depletion region is of the form.....

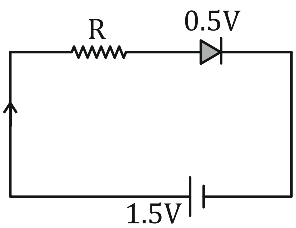
(A)


(B)


(C)


(D)


10. The diode employed in the depicted circuit has a constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milliwatts. What value should the resistor R have, connected in series with the diode, in order to achieve maximum current?



(A) 1.5 Ω (B) 5 Ω (C) 6.67 Ω (D) 200 Ω

11. The antenna current of an AM transmitter is 8A when only carrier is sent but increases to 8.96 A when the carrier is sinusoidally modulated. The percentage modulation is

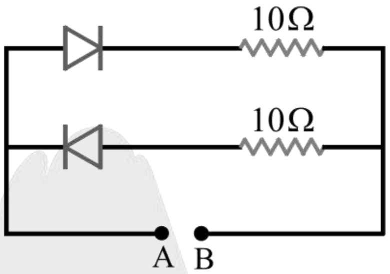
12. An optical fibre communication system works on a wavelength of $1.3\mu m$. The number of subscribers it can feed if a channel requires 20 kHz are

(A) 2.3×10^{10} (B) 1.15×10^{10} (C) 1×10^{5} (D) none of these

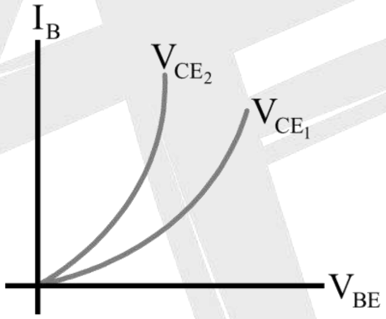
PROFICIENCY TEST-III

1. A transistor is connected in common emitter (CE) configuration. The collector supply is 8 V and the voltage drop across a resistor of 800 Ω in the collector circuit is 0.5 V. If the current gain factor α is 0.96, find the base current (in μA).

2. A 2 V battery is connected across the points A and B as shown in the figure given below. The current supplied by the battery when its positive terminal is connected to A is $\frac{2}{n}A$. Find n?

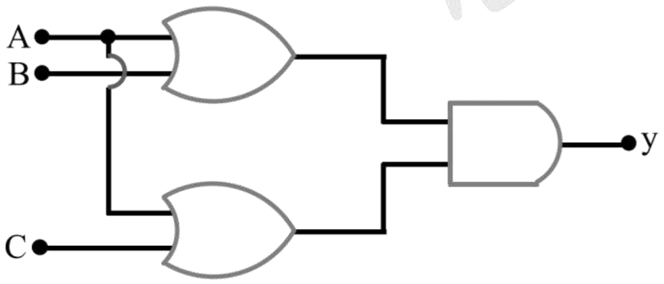


3. In an experiment input characteristics are shown for CE configuration of n-p-n transistor for different output voltages. Here :



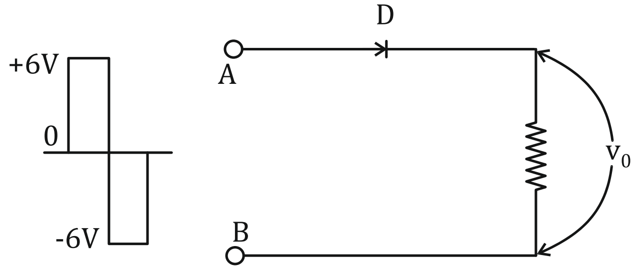
(A) $V_{CE_1} > V_{CE_2}$
(B) $V_{CE_1} = V_{CE_2}$
(C) $V_{CE_1} < V_{CE_2}$
(D) $V_{CE_1} = 2V_{CE_2}$

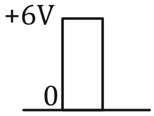
4. The output of given logic circuit is :

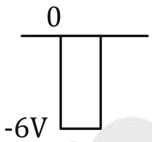


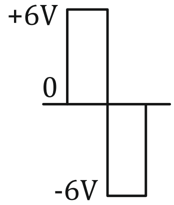
(A) $A\cdot(B+C)$
(B) $A\cdot(B\cdot C)$
(C) $(A+B)\cdot(A+C)$
(D) $(A+B)\cdot C$

5. In the depicted figure below, the value of V_0 will be



(A) 

(B) 

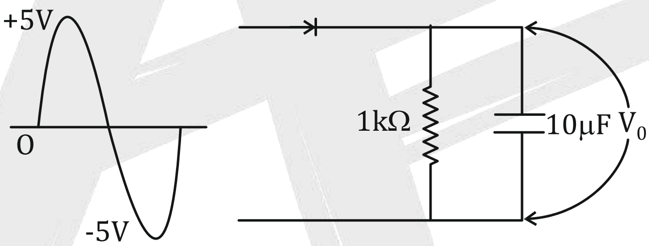
(C) 

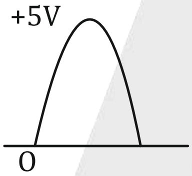
(D) None of these

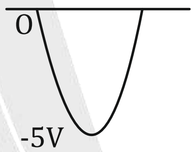
6. If α of a transistor is 0.95 then β of the transistor is

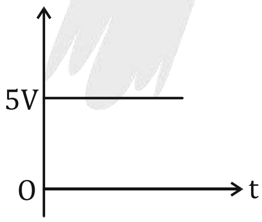
(A) 20 (B) 19 (C) 21 (D) None of these

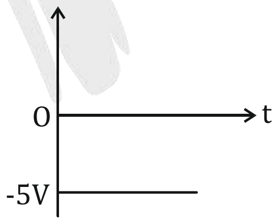
7. The output in the circuit shown in the figure is taken across a capacitor, resulting in ________ as indicated in the figure.



(A) 

(B) 

(C) 

(D) 

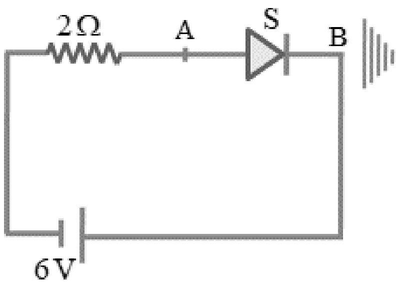
8. In a pure silicon $\left(n_i = 10^{16} / m^3\right)$ crystal at 300 K, 10^{21} atoms of phosphorus are added per cubic meter. The new hole concentration will be

(A) 10^{21} per m^3 (B) 10^{19} per m^3 (C) 10^{11} per m^3 (D) 10^{5} per m^3

9. The maximum efficiency fo full wave rectifier is

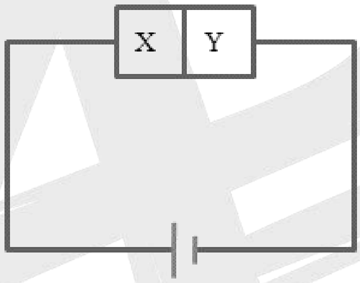
(A) 100% (B) 25.20% (C) 40.2% (D) 81.2%

10. If the diode shown in the circuit is a silicon diode, the potential difference between points A and B will be



(A) 6 V (B) 0.6 V (C) 0.7 V (D) 0 V

11. Among the given statements, which one is correct regarding the configuration where a semiconductor X, doped with arsenic (Z = 33), is joined with a semiconductor Y, doped with indium (Z = 49), and connected to a battery as illustrated in the figure?



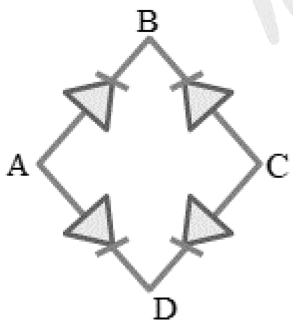
(A) X is P-type, Y is N-type and the junction is forward biased

(B) X is N-type, Y is P-type and the junction is forward biased

(C) X is P-type, Y is N-type and the junction is reverse biased

(D) X is N-type, N is P-type and the junction is reverse biased

12. In the provided diagram, where the input is applied across terminals A and C and the output is measured across terminals B and D, the output is



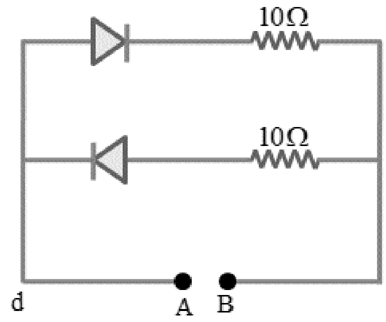
(A) Zero

(B) Same as input

(C) Full wave rectifier

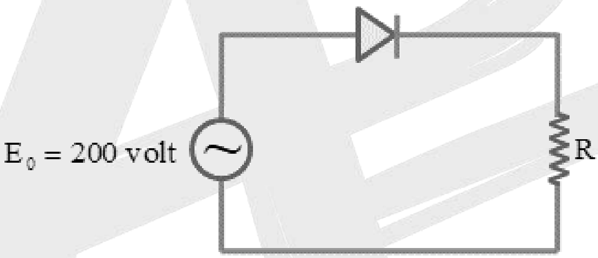
(D) Half wave rectifier

13. In the given figure below, a 2V battery is connected across points A and B. Assuming that the resistance of each diode is zero in forward bias and infinity in reverse bias, calculate the current supplied by the battery when its positive terminal is connected to A.



(A) 0.2 A (B) 0.4 A (C) Zero (D) 0.1 A

14. A sinusoidal voltage with a peak value of 200 volts is applied to a circuit consisting of a diode and resistor R, allowing for half-wave rectification. Assuming that the forward resistance of the diode is negligible compared to R, the RMS voltage (in volts) across R is approximately



(A) 200 (B) 100 (C) $\frac{200}{\sqrt{2}}$ (D) 280

ANSWER KEY

EXERCISE-I

1	2	3	4	5	6	7	8	9	10
C	D	A	B	A	D	C	C	C	50
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	B	A	B	C	B	B	B	C	C
21	**22**	**23**	**24**						
3	40	B	A						

EXERCISE-II

1	2	3	4	5	6	7	8	9	10
C	D	B	D	A	B	C	A	B	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	C	A	C	A	C	B	A	A	A
21	**22**								
B	1000								

EXERCISE-III

1	2	3	4	5	6	7	8	9	10
8653	D	2	300	B	2	B	A	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	D	D	A	A	B	A	10	D	C
21	**22**								
B	B								

EXERCISE-IV

1	2	3	4	5	6	7	8	9	10
D	C	B	C	D	B	D	C	5	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	A	A	D	C	B	C	B	10	3

EXERCISE-V

1	2	3	4	5	6	7	8	9	10
5	B	A	D	C	D	D	B	B	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	B	82	D	A	C	A	B	A	D
21									
C									

PROFICIENCY TEST-I

1	2	3	4	5	6	7	8	9	10
16	10	80	B	B	A	C	B	B	C
11	**12**	**13**							
A	C	B							

PROFICIENCY TEST-II

1	2	3	4	5	6	7	8	9	10
C	D	250	B	D	B	D	D	B	B
11	**12**								
71	B								

PROFICIENCY TEST-III

1	2	3	4	5	6	7	8	9	10
26	10	A	C	A	B	C	C	D	A
11	**12**	**13**	**14**						
D	C	A	B						