Electronics

(Diodes)

Semiconducting Semiconductor are a special class of elements having a conductivity between that of a good conductor and that of an insulator. exg Si, Ge, GaAs

Semiconductor (অর্ধপরিবাহী)

(1) What is Doping process?

=> Doping is the process of adding some impurity atom(Al, B, In, P, As, Bi) in a pure semiconductor (Si, Ge, GaAs) so as to increase the conductivity of a semiconductor.

[Doping বলতে বুঝায় ~~semi~~ বিশুদ্ধ Semiconductor (Si, Ge, GaAs) এর সাথে সামান্য পরিমাণ (যেমন (P, As, Al) ~~for~~ মিশ্রিয়ে semiconductor এর পরিবাহিতা বহুল পরিমাণে বৃদ্ধি করা)

অপদ্রব্য যুক্ত ১ম উদাহরণ। ত্রিযোজী মৌল ঃ

Al (13) → $1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p_x^1\ 3p_y^1\ 3p_z^0$

B (5) → $1s^2\ 2s^2\ 2p^1$

→ $1s^2\ 2s^1\ 2p_x^1\ 2p_y^1$

In (49) → (Kr) $4d^{10}\ 5s^1\ 5p_x^1\ 5p_y^1\ 5p_z^0$

পঞ্চযোজী → .

P (15) → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p_x^1\ 3p_y^1\ 3p_z^1$

As, Bi

(ii) What is p-type ?

=> A p-type semiconductor is an intrinsic (খাঁটি) semiconductor doped with Boron (B), Al, In ; The majority of carriers in p-type semiconductors are holes. Electrons are minority carrics in a p-type.

(iii) What is n-type semiconductor?

=> An n-type semiconductor is an intrinsic semiconductor doped with phosphorus(p), arsenic (As), or antimony (Sb) as an impurity. The majority of carries are holes and minority carries are electrons.

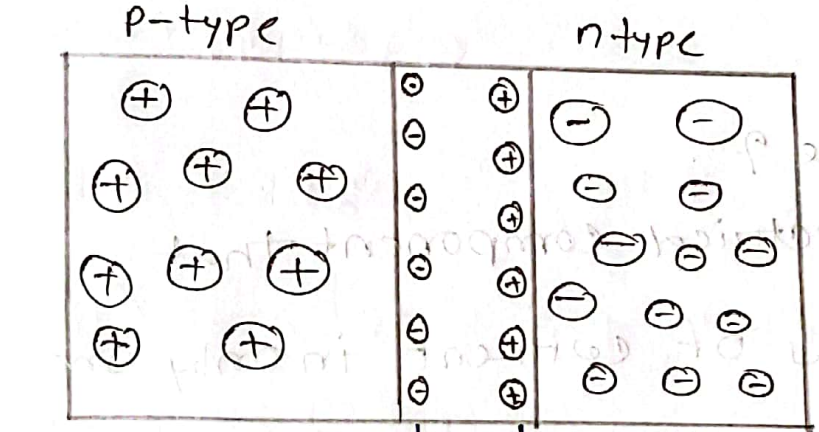


figure: P-n junction

P-type এর minority মুলো এদের side এ হবে।

n-type এর minority মুলো এদের side এ হবে।

Depletion Region (এটা কিছুটা capacit... ধারণ করে)

Imp: The potential difference V_D হলো Depletion Region এর limit এ প্রয়োজন Supply Voltage এর value এবং V_D এর যেকি ~~Depletion~~

Depletion layer বলতে কি বুঝ?

The potential difference V_D across the junction is called potential Barrier as it ~~prevents~~ prevents further movement of holes and electrons.

(1) What is diode?

=> Diode, an electrical component that allows the flow of current in only one direction. It is a two terminal electrical device

(2) What is a diode used for?

=> Diodes can be used as switches, rectifiers, signal limiters, voltage regulators, signal modulators, signal demodulators, Oscillators.

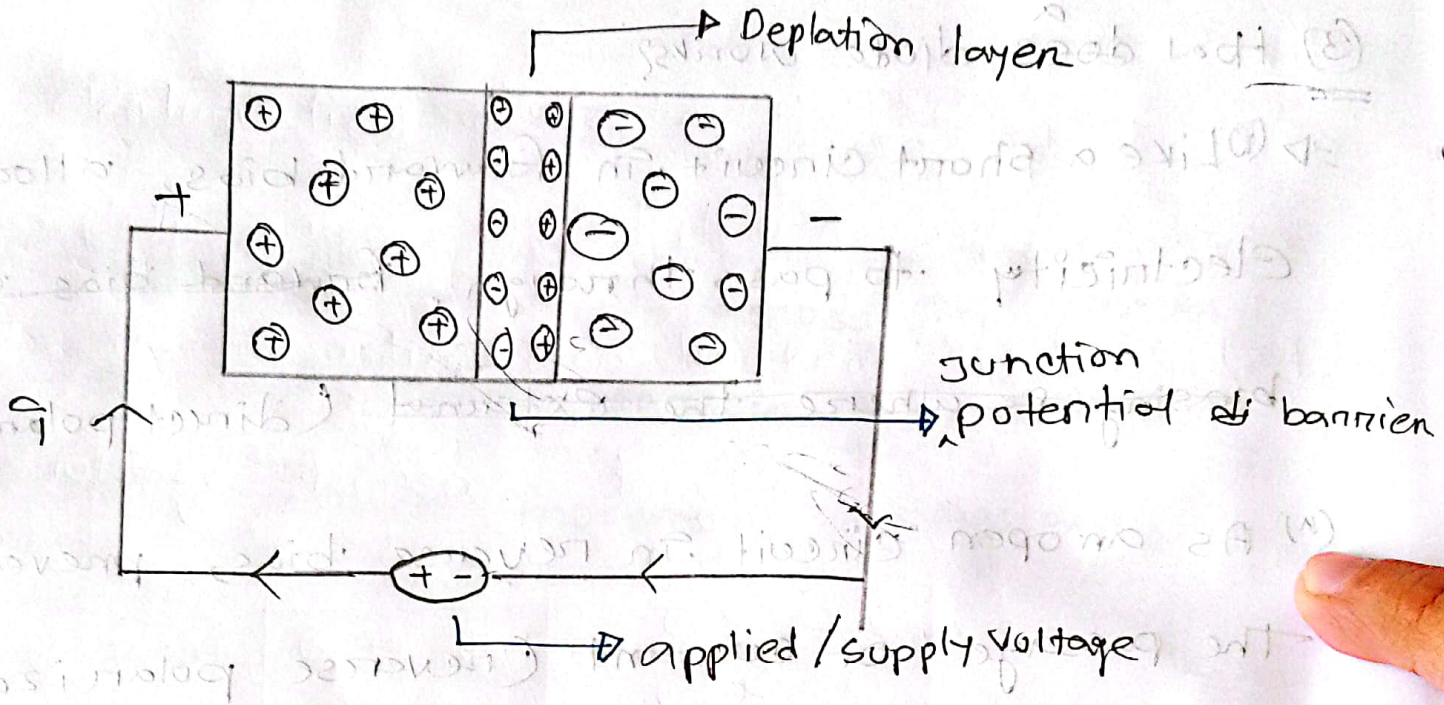
(3) How does a diode works?

=> (i) Like a short circuit in forward bias, allowing electricity to pass through. ~~forward bias or biasing is where the external~~ (direct polarization)

(ii) As an open circuit in reverse bias, preventing the passage of current (reverse polarization)

(4) What is forward bias?

=> forward bias or biasing is where the external voltage is delivered across the p-n junction diode. In a forward bias setup, the p-side of the diode is attached to the postive terminal, and N-side is fixed to the Negative of the battery or supply voltage. ~~Here, the~~



Here the applied voltage is opposite to the junction barrier potential. Due to this, the effective potential barrier and junction width decrease, which further result in more majority of carriers flowing across the junction. ~~Moreover, when we increase the value of supply voltage~~ ∴ The forward bias pn-junction forces the majority of charge carries to move across the junction. Due to this reason, there is a decrease in the width of the depletion layer.

Once the junction is crossed, Each hole on the p side combines with an electron that is from the N side. Due to this reason, a co covalent bond will break, and an electron generated from the covalent bond move towards the positive terminal.

(5) What is reverse bias?

=> Reverse bias is a process ~~where~~, which blocks the current flow across a p-n junction in the presence of supply voltage. When the p-type is connected to the battery's negative terminal and the n-type is connected to the positive side, the p-N junction is reverse biased. In this case, the built in electrical field and the applied electric field are in the same direction, when the two fields is in the same direction as the bui

in electric field, creating a more resistive, thicker depletion region. The depletion region becomes more resistive and thicker if the applied voltage becomes larger.

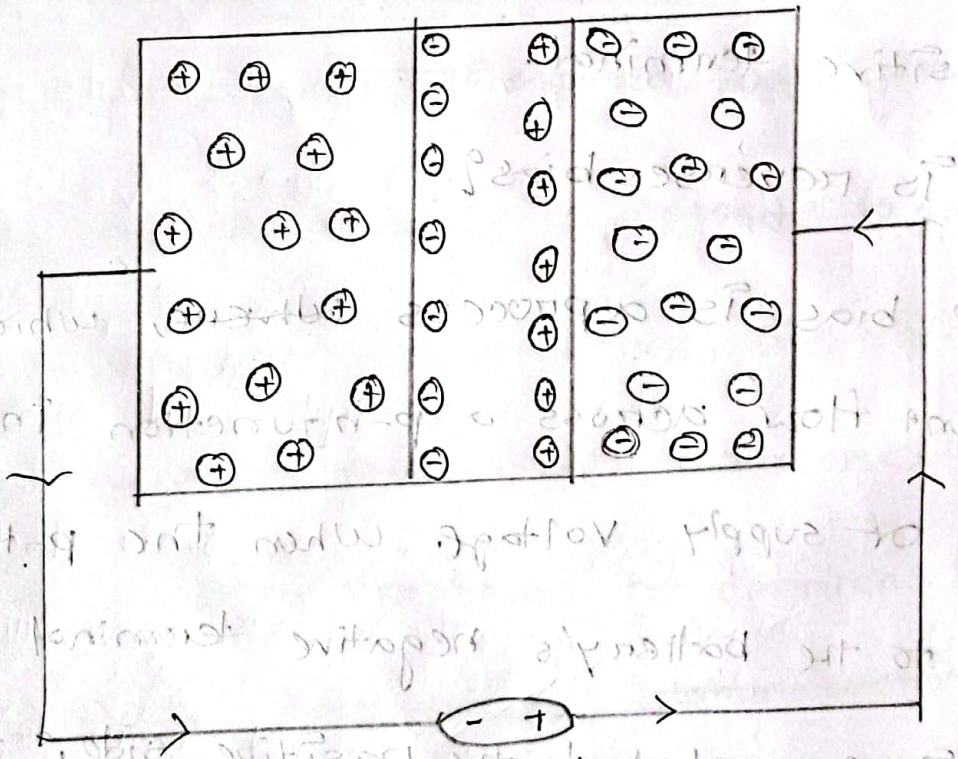
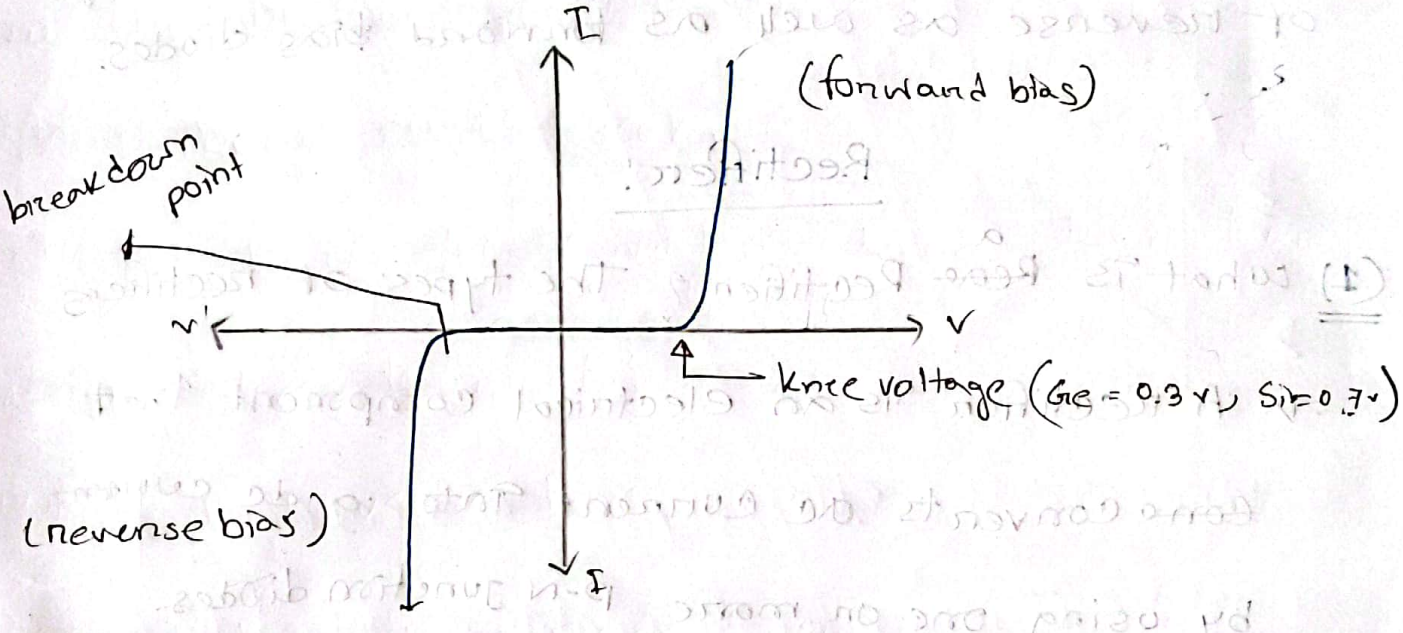


figure: reverse biased

(6) I–V Characteristic curve in forward and reverse bias:



Both IV characteristic of forward bias and reverse bias are different. In forward bias, there is an easy path for the flow of current, while in reverse bias, forward current is small. As the depletion layer is thick, there is higher resistance to the flow of current. In general terms, reverse bias diodes prevent charge carriers from moving in the circuit. They have a much higher potential difference to increase the strength of the barrier. The characteristic ~~curve relation~~

curve give an idea about the IV-characteristics or relation between the current and voltage of reverse as well as forward bias diodes.

Rectifier:

(1) What is ~~Rear~~ a Rectifier? The types of rectifiers

⇒ A rectifier is an electrical component that ~~Cone~~ converts ac current into a dc current by using one or more p-n junction diodes

There are ~~three~~ two types of rectifiers;

(i) half wave ~~rectifier~~ rectifier

(ii) full wave ~~Centre tapped bridge rectifiers~~ rectifier

~~(iii) full wave bridge rectifiers.~~

~~Rectification methods are two types:~~

(i) half wave

(ii) full wave

~~for~~ full wave rectifier are two types:.

(1) Centre tape full wave rectifier.

(11) full wave Bridge rectifier.

(2) Application of rectifiers:

(1) rectifiers are used in electric welding to provide polarized voltage,

(11) Half wave rectifiers are used as a signal peak detector in Am radio.

(111) Rectifiers are used in modulation, demodulation, and voltage mutipliens.

3 why we do use rectifiers?

~~=> As we all All electrical appliances~~

=> All electrical appliances use a DC power supply to function. using a rectifier in the power supply helps in converting AC to DC power supply. Bridge Rectifiers are widely used for large ~~appli~~ appliances, which can convert high AC voltag

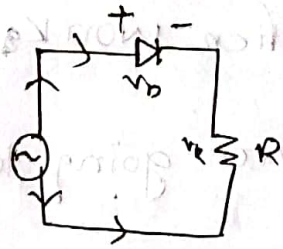
(4) What is the effeciency of a rectifier?

=> The efficiency of a rectifier is defined as the ration of DC ~~output~~ ouput power to the applied AC input.

(5) What is half wave?

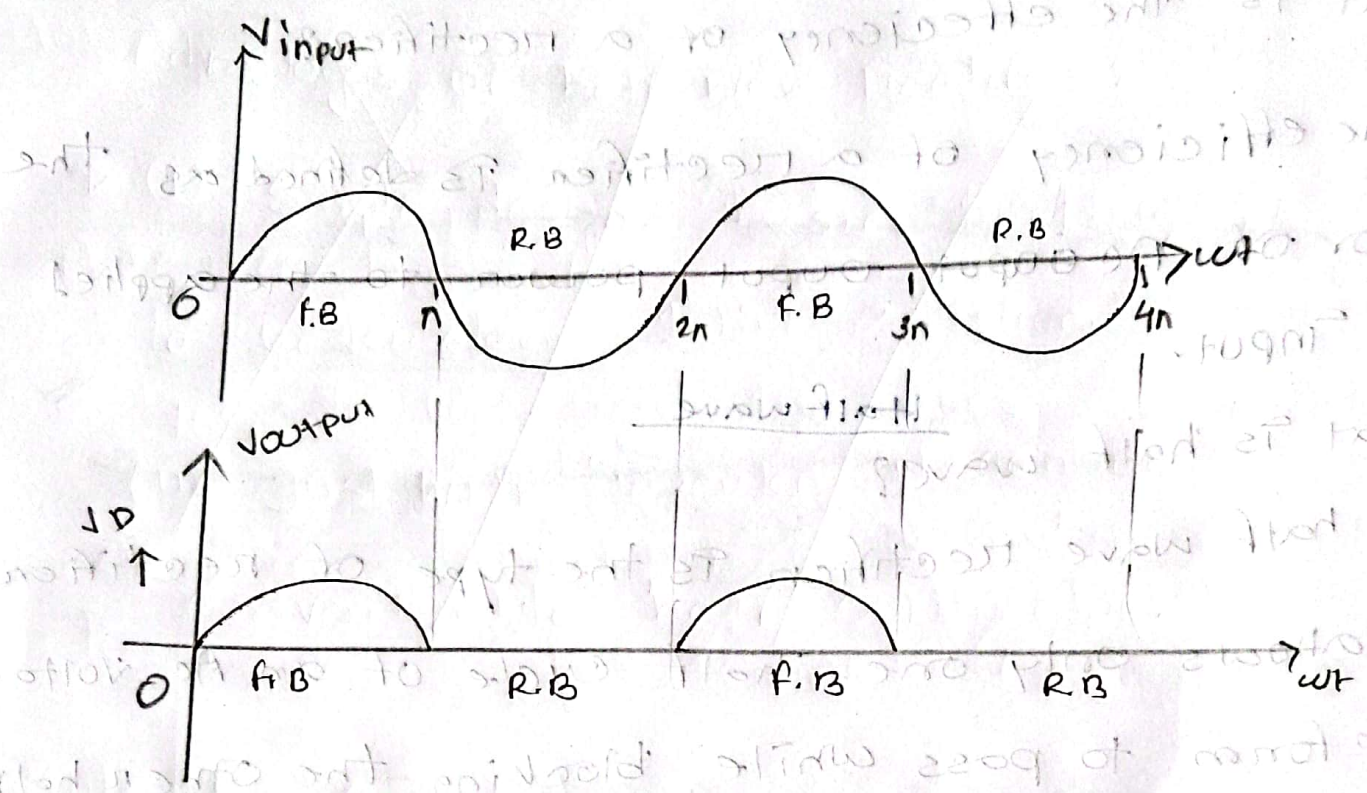
Half wave

=> A half wave rectifier is the type of rectifier that allows only one-half cycle of an AC voltage waveform to pass while blocking the other half cycle. Half wave ~~from~~ rectifier transforms AC current into DC current by using only one Diode.



(6) Half wave rectifier wave form?

=> The halfwave rectifier waveform before and after rectification is shown below in the figure.



F.B → forward bias

R.B → Reverse Bias

(7) How does a half wave rectifier works?

⇒ In this section, we are going to understand how a rectifier works:

1. A high AC voltage is applied to the primary side of the step-down transformer.

The obtained secondary low voltage is applied to the diode.

2. The diode is forward biased during the positive half cycle of the AC voltage and reverse biased during the negative half cycle.

(3) The final output voltage waveform is as shown in the figure below.

(4) Applications of half wave rectifiers

⇒ (i) They are used for signal demodulation purpose

(ii) They are used for rectification application

(iii) They are used for signal peak applications.

(5) Disadvantage of half wave rectifiers

(i) power loss

(ii) Low output voltage

(iii) The output contains a lot of ripples.

(10) Advantages of half wave rectifier

=> (i) Half wave rectifier is a simple circuit

(ii) It has a low cost.

(iii) We can easy to use it.

(iv) We can easily construct.

(v) It has a low number of components

therefore it is cheap.

(21) where do we use a half wave rectifier?

=> A half wave rectifier is used in firing circuits and pulse generating circuits. Half wave rectifiers are used along with step up and step down transformers to achieve the desired voltage.

full wave:

(1) what is a full wave rectifier?

=> A full wave rectifier is the type of rectifier that converts the complete cycle of alternating current into pulsating DC. full wave rectifier utilize the full cycle. The

(2) Types of full wave rectifier?

=> There are two types of full wave rectifier

(1) central tapped full wave rectifier

(2) Bridge rectifier.

⊞ Centre tapped full wave rectifier:

A centre tapped full wave rectifier is a type of rectifier that uses a centre transformer and two diodes to convert the complete Ac signal into Dc signal.

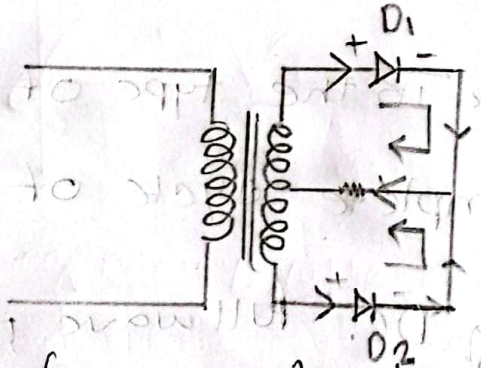


figure: centre tapped full wave rectifier.

(3) working process of centre tapped full wave rectifier?

⇒ ~~The cent~~ In centre tapped full wave rectifier, when input AC voltage is applied, the secon winding of the centre tapped transformer

The divides of this input AC voltage into two parts:

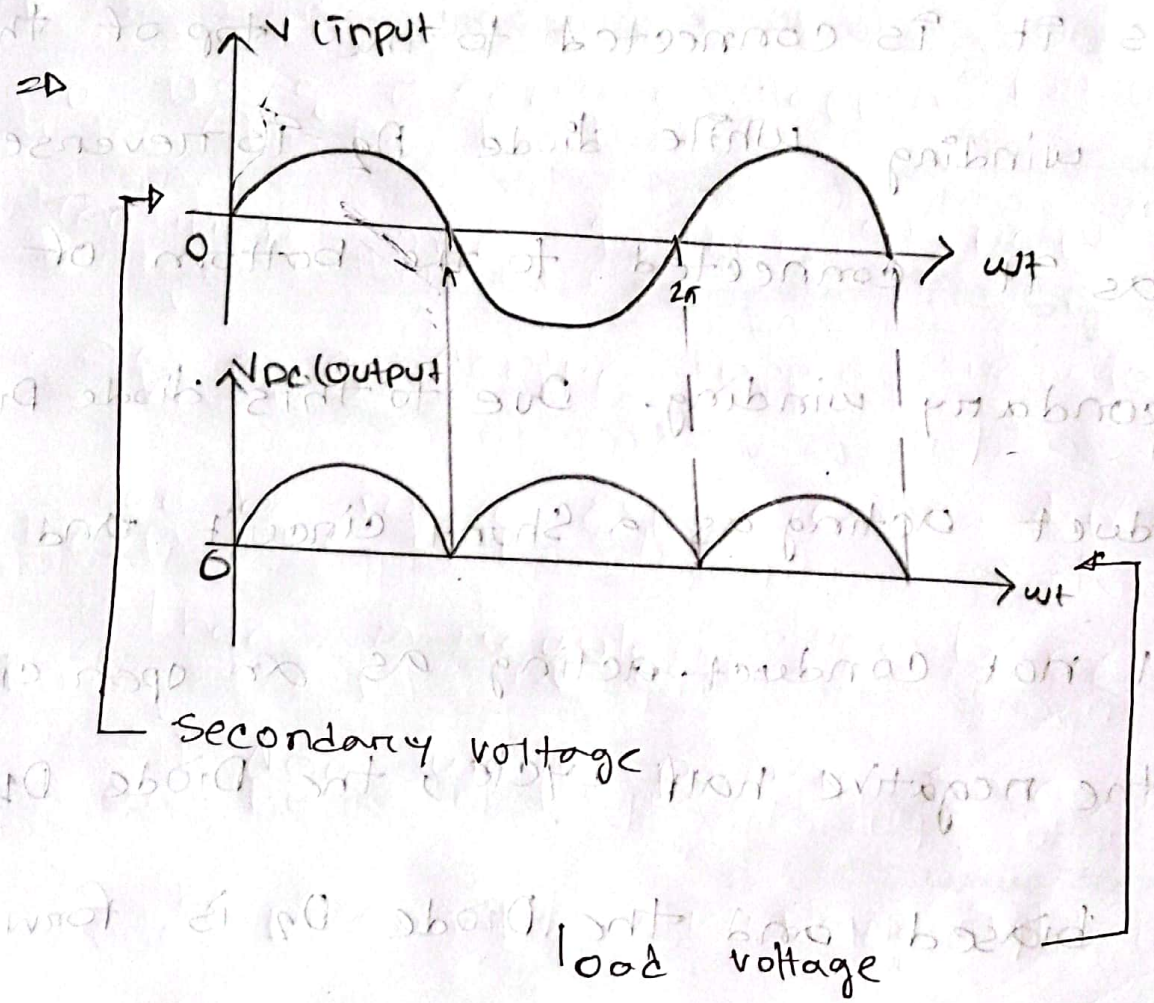
* positive and negative.

- During the positive half cycle, diode D_1 is forward biased as it is connected to the top of the secondary winding while diode D_2 is reversed Biased as it connected to the bottom of the secondary winding. Due to this diode D_1 will conduct acting as a short circuit and D_2 will not conduct acting as an open circuit
- During the negative half cycle, the Diode D_1 is reverse biased and the Diode D_2 is forward biased because the top half of the secondary circuit becomes negative and the bottom half of the circuit becomes positive. thus in a full wave rectifiers, DC voltage is obtained for both positive and negative

half cycle.

(4) Centre tapped full wave rectifier

wave forming



(5) Where do we use centre tapped ~~for~~ rectifier? / applications of centre tapped rectifier:

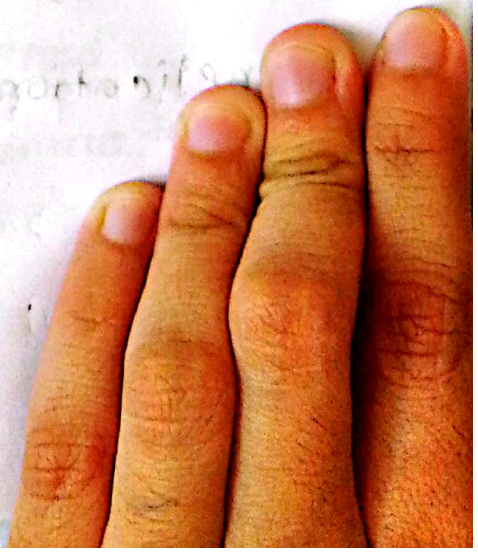
⇒

(6) Advantages of ~~full~~ centre tapped full wave rectifier?

⇒ The main advantage of the centre-tapped full wave rectifier is that it produces a higher DC output voltage than a half wave rectifier, while still being ~~relative~~ relatively simple and inexpensive. It also has a lower ripple voltage than a half wave rectifier, which can be important for some applications.

(7) Disadvantage of centre tapped full wave rectifier:

=> There are also some disadvantage to using a centre tapped full wave rectifier. one is that it requires a centre tapped transformer, which can be more expensive and difficult to find than a regular transformer. Additionally, it can waste power since only half of the secondary winding is being used at any given time.



full wave Bridge rectifier:

(8) what is a full wave bridge rectifiers?

=> A bridge rectifier is a type of full wave rectifier that uses four diodes (D_1, D_2, D_3, D_4) in a bridge configuration to convert an alternating current (AC) input signal into a direct current (DC) output signal.

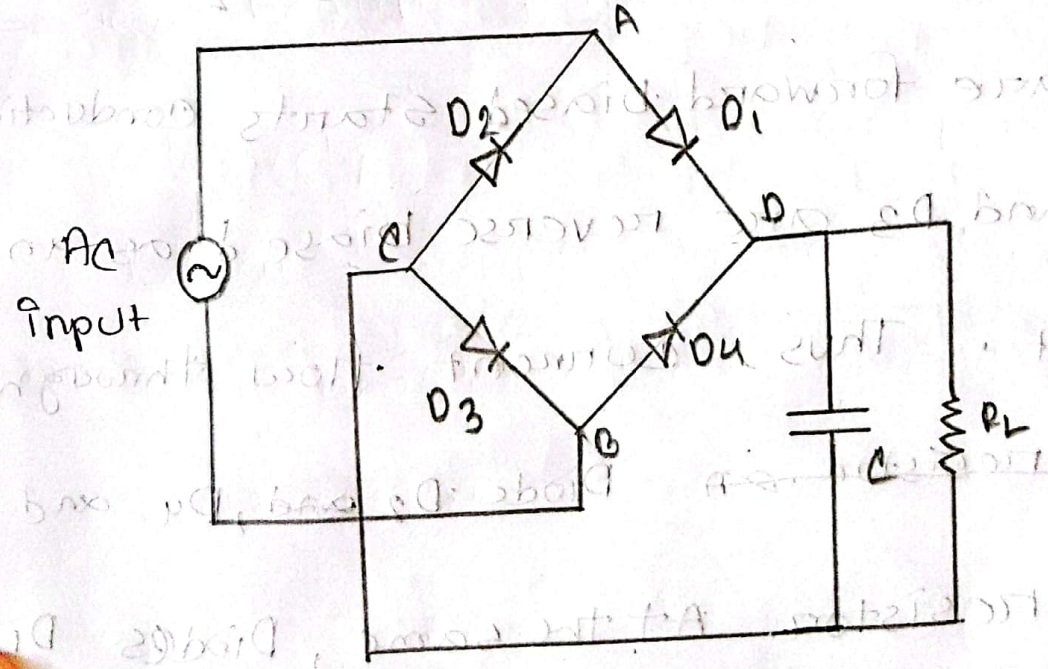


figure: ~~centre tap~~ bridge rectifiers.

~~• positive half cycle~~

(9) Working process of bridge rectifier?

⇒ In bridge rectifier, there are 4 diodes (D_1, D_2, D_3, D_4) arranged as a bridge. Therefore, this arrangement is know as a bridge Rectifier.

• The positive half-cycle:

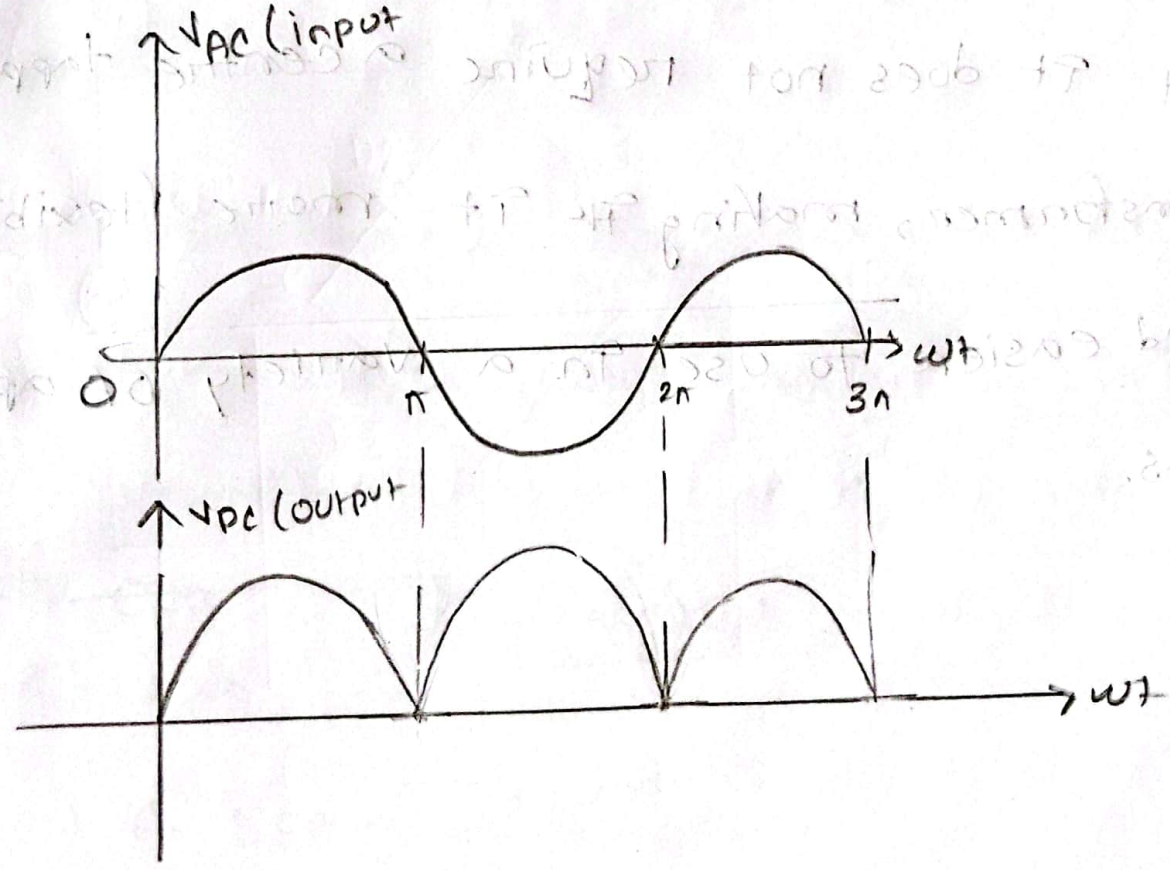
During the positive half cycle, diodes D_2 ~~At~~ and D_4 are forward biased starts conducting. diodes D_1 and D_3 are reverse biased as an open circuit. Thus, current flow through ~~the load resistor.~~ Diode D_2 ~~and~~, D_4 and the load resistor. At the same, Diodes D_1 and D_3 block the current from flowing in that direction.

- **During the Negative Half cycle:**

During the Negative half cycle, the diodes D_3 and D_1 are forward biased and start conducting, while D_4 and D_2 remain are reverse biased and remain switched off. Thus, current flow through D_1, D_3 and the load resistor.

(10) wave form of bridge rectifier:

=>



(11) Advantages of the bridge rectifier:

=> The main advantage of the bridge rectifier is that it produces a higher DC output voltage than a half wave rectifier or a centre tapped full wave rectifier. It also has a lower ripple voltage than a half wave rectifier making it suitable for many electronic applications, another advantage is that it does not require a centre tapped transformer, making it more flexible and easier to use in a variety of applications.

(12) Disadvantage of the Bridge Rectifier:

=> It requires four diodes, which are more expensive than two diodes used in a half-wave rectifier or the two diodes used in a center tapped full wave rectifier. It also has a higher peak inverse voltage than a half wave rectifier, which can require a higher voltage rating of diodes in high voltages applications.

(13) Applications of Bridge Rectifier:

=> (i) Mobile phones, laptops, charger circuit.

(ii) Uninterruptible power supply circuits to convert AC to DC

~~(iii) Our home int~~

(iii) LCD, LED TVs.

(iv) Go LED Driver circuits.

(v) Audio Amplifier

(vi) Radios

full wave bridge ~~rectifiers~~ rectifiers are mostly used for the low cost of ~~do~~ diodes, because of being lightweight and highly efficient.

(14) Advantage and ~~dist~~ disadvantage of full wave rectifiers:

Advantage:

⇒ (1) Higher average output voltage: full wave rectifier produces a higher average output voltage compared to a half wave rectifier, which makes it more efficient for many applications.

(2) Higher rectification efficiency: The full-wave rectifier has a higher rectification efficiency compared to a half-wave rectifier, as it uses both halves of the input signal cycle to produce a DC output voltage.

(3) Lower ripple voltage: The full-wave rectifier produces a lower ripple voltage compared to a half-wave rectifier, as it uses both halves of the input signal to produce a smoother DC output voltage.

(4) Flexibility: A full wave rectifier can be construct-ed using either a centre-tapped transformer or a bridge rectifier configuration, making it more flexible and easier to use in a variety of applications.

disadvantage:

(1) **More expensive:** A full wave rectifier requires four diodes, which can make it more expensive than a half-wave rectifier that only requires two diodes.

(2) **More complex:** The full wave rectifier circuit is more complex compared to a half wave rectifier, as it requires more diodes and a centre tapped transformer or a bridge rectifier circuit.

(3) **Higher power loss:** The full-wave rectifier has a higher power loss compared to a half wave rectifier, as it has two

diodes conducting current at any given time, which leads to a higher voltage drop across the diodes.

(15) which rectifier has best efficiency?

=> The most effective rectifier circuit among them is the bridge rectifier. because a bridge rectifie uses the same secondary voltage as a centre tapped rectifier but generates an output volta that is nearly twice as high. Bridge rectifi also offer a rectification efficiency that is doubled when compared to half wave rectifiers