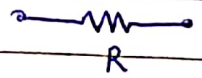
Date : / /
Page :

BASICS OF ELECTRONIC ENG.

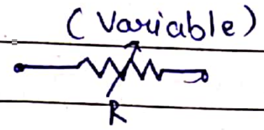
Basic Electronic Comp (R, L, C)
Semiconductors, Ins., Cond; Energy band diag
Intrinsic & Extrinsic Semiconductors.

1. Resistor :- (R) : ohms

(Fixed)

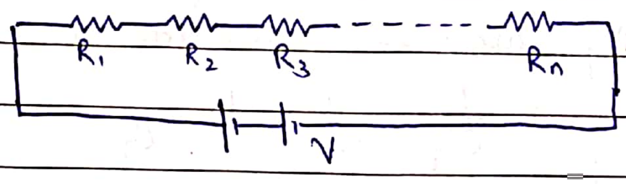


(Variable)



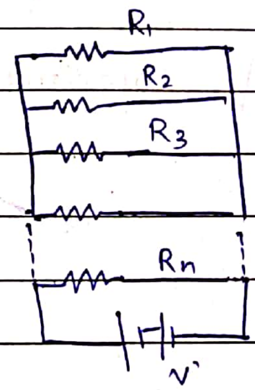
Resistance in series

$R_{eq} = R_1 + R_2 + --- R_n$



$I_{eq} = \frac{V}{R_{eq}}$

Resistance in parallel



$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} --- \frac{1}{R_n}$

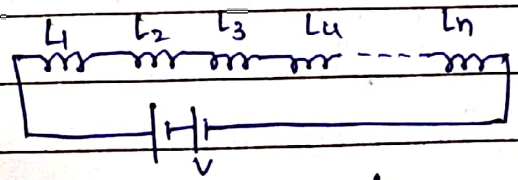
$I_{eq} = \frac{V}{R_{eq}}$

★ R_{eq} is small than smallest resistance in parallel comb.

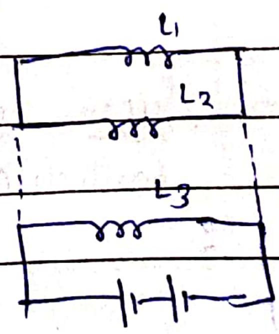
2. Inductors (L) : Henry

Inductors in series.

$L_{eq} = L_1 + L_2 --- L_n$



Inductors in parallel



$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + --- \frac{1}{L_n}$.

$\boxed{V = L\frac{dI}{dt}}$ (series)

Date : / /
Page :

Parallel $V = L\frac{dI}{dt}$

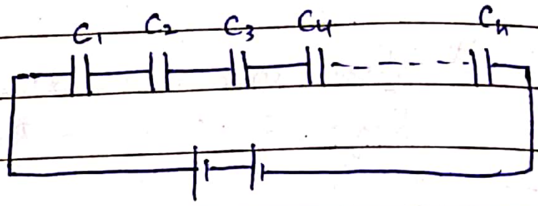
$$\frac{dI}{dt} = \frac{V}{L}$$

$$dI = \frac{V}{L}\,dt$$

$$I = \frac{1}{L}\int V\,dt$$

3. Capacitors (C) : Farad (F)

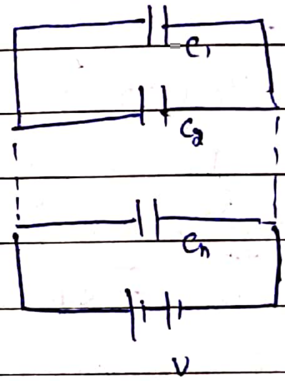
Capacitors connected in series



$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots \frac{1}{C_n}$$

$$Q = CV$$

Capacitors connected in parallel



$$C_{eq} = C_1 + C_2 + \cdots C_n$$

4. Conductors - It is a device which offers minimum resistance to flow of current. ~~They are better conductors~~ Copper, Aluminium. In case of conductor, no of valence e^- will be 1 or 2

→ Semiconductor - eg silicon, germanium

→ Insulator - eg wood, plastic, rubber

5. Super conductor - which offer zero resistance at particular temp eg mercury at 0 K

6. **Semiconductor** - have conductivity more than insulators but less than conductors eg- silicon. In them, outermost orbit is partially filled. In cases of silicon and germanium, valence ele. are 4

7. **Insulators** - In case of insulator, outermost orbit is completely filled.

⇨ ENERGY BAND STRUCTURE

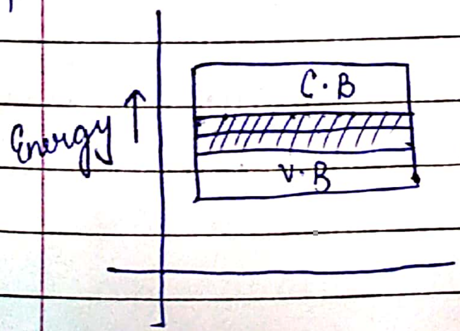
The range of energies that an e^- may posses in an atom is known as energy band

(1) Valence band - The range of energies possesed by valence e^- is known as valence band

(2) Conduction band :- The range of energies possesed by e^- that are taking part in conduction process.

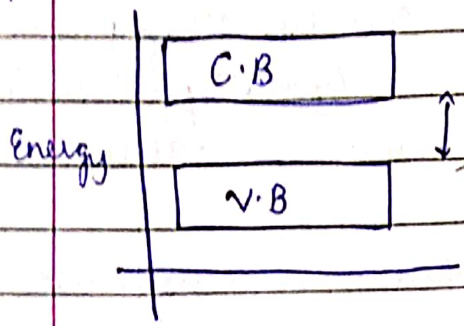
(3) Forbidden band : The energy band in between conduction band and valence band

For Conductors

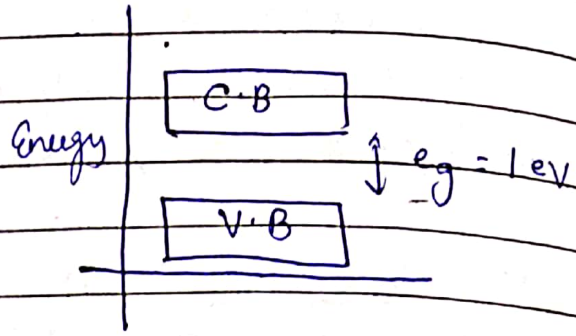


overlapping of valence band and Conduction band.

For insulators



For semiconductor



8. Intrinsic Semiconductor:
A pure semiconductor is called intrinsic semiconductor

At room temperature, some of valence e^- ~~ga~~ ~~acquire~~ require sufficient energy to enter conduction band

→ For pure semiconductors, no of e^- (-ve) are equal to no of holes (+ve)

9. Extrinsic Semiconductor: Due to poor conduction at room temperature, intrinsic semiconductor is not useful for electronic devices. Hence current conduction capability of intrinsic semiconductor should be increased. This can be done by adding small amount of impurity to intrinsic semiconductor. The semiconductor obtained after this is known as extrinsic semiconductor

10. Doping - To add impurities to intrinsic semiconductor to increase conductivity.

Date: / /
Page:

11. p-type semiconductor - A small amount of trivalent impurities such as Al, B is added to pure semiconductor, then we get p-type semiconductor.

Intrinsic + Trivalent Impf = p-type semiconductor
Acceptor Impurity

Silicon or Ge has 4 valence e^- whereas trivalent impurity has 3 valence e^-. 3 ~~value~~ valence e^- of Trivalent impurity form 3 covalent bond with surrounding atoms of Si of or Ge. leaving one bond incomplete which gives rise to hole

In complete process we are left with large no. of holes in valence band. This type of semiconductor is known as p-type Semiconductor holes are majority carriers and e^- are minority carriers

12. n-type semiconductor - e^- are majority carriers. A small amount of pentavalent impurities such as P, As, Antimony is added to pure S.C, we get n-type S.C

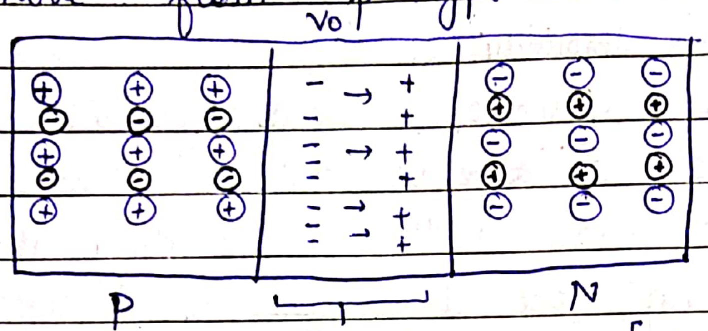
Intrinsic + Pentavalent Imp/ = n-type semiconductor
Donor Impurity

P-N Junction Diode

A p-n junction is formed if one half of the material is doped by p-type impurity and other half is doped by n-type impurity.
It is undirectional device, used as switch
The plane dividing the two zones is known as p-n junction. The n-type material has high concentration of free e^- whereas p-type material has high concentration of holes.

Date : / /
Page :

Diffusion- At the junction if free e^- in n-type region move over to the p-type region where they have less concenteration, Similary holes will move from p-type to n-type.



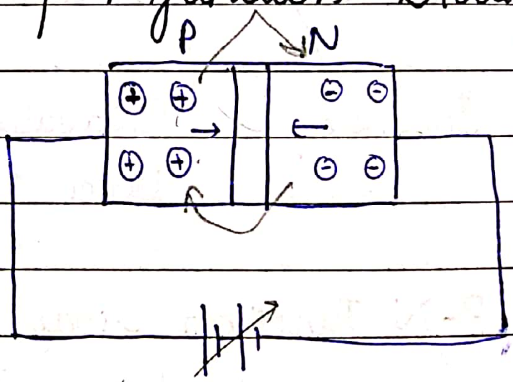
[V_0 → potential barrier / Junction potential)

A barrier is set up near the junction which prevents further mov. of charge carrier is called barrier potential

For Si, the value of V_0 is 0.7 V

For Ge, the value of V_0 is 0.3 v

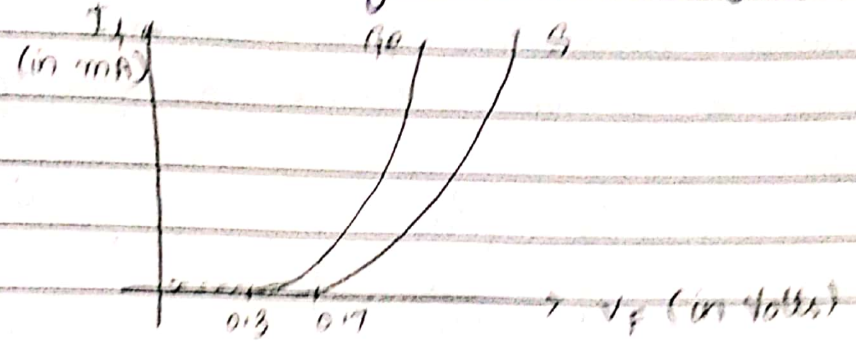
Forward Biasing Of p-n junction Diode.



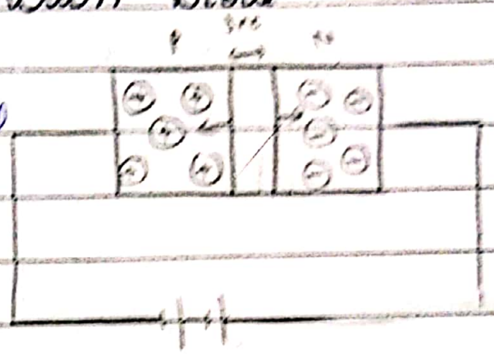
Under the forward biased, positive terminal is attatched to p-type and neg. terminal with n-type. Holes move towards n-types and e^- move towards p-type Due to this depletion layer will decrease.

When applied voltage is more than barrier potential then depletion region will disappear.

V-I characteristics of a Forward Biased P-N junction

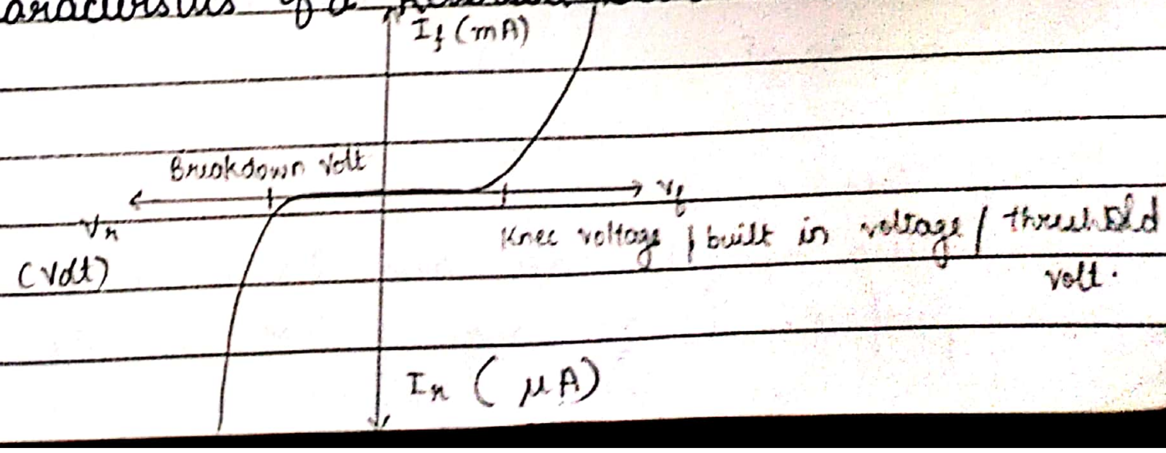


Reverse biasing of a p-n Junction Diode



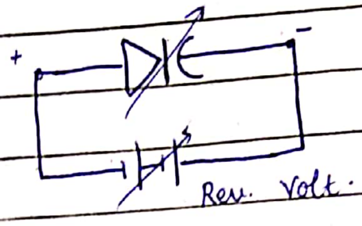
Under reverse biased, +ve terminal of battery is connected with n-type region and -ve terminal is connected with p-type. Depletion layer will increase. The electric field prod. by applied reverse biased is in same direction as electric field of potential barrier. Hence resistance potential barrier increases which prevent flow of majority carriers in both direction. But small current is produced due to flow of minority carriers. This current is known as reverse saturation current. The magnitude of reverse saturation current depends upon junction temperature because major source of minority carriers is thermally broken covalent bond.

V-I characteristics of a Reversed Biased P-N Junction



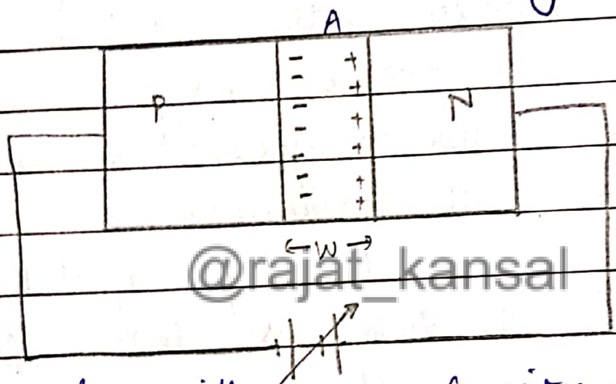
Date: / /
Page:

Varactor Diode – The varactor diode provides us variable capacitance value when it is $\boxed{\text{reverse}}$ biased. It is also known as Varicap



$$C = \frac{K}{\sqrt{\text{reverse volt } (V_R)}}$$

This diode has a useful property that its capacitance can be varied electronically



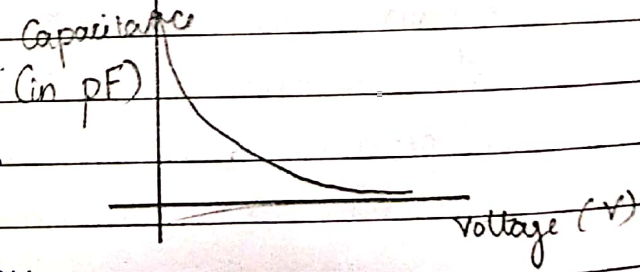
$$C = \frac{\epsilon_0 A}{W}$$ W → Width of depletion layer

$$C = \frac{\epsilon_0 \epsilon_r A}{W}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$$

The depletion layer will act as Capacitor

As C and w are inversely proporsed so increase in reverse voltage, width increase Therefore capacitance decrease.



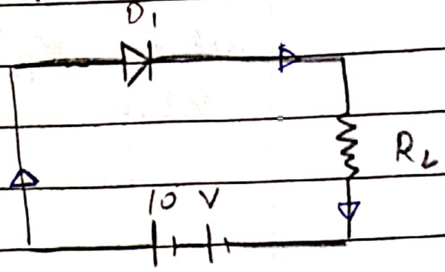
At 0 V, w is small and capacitance value is app 600 pF

When reverse voltage across varactor diode is 15 V then its capacitance value will be 30 pF

Uses

Used in FM radio and TV receivers for tuning purpose. (Freq. range of FM is 98 - 108 MHz).

Ques The Si diode D_1 is rated for max current of 100 mA. Calculate min. value of resistor R_L. Assume forward voltage drop across diode to be 0.7 V



$I_{max} = 100\ mA$

$R_L = ?$

$$\boxed{\begin{array}{c}\text{Kirchoff's voltage law} \\ (V_1 + V_2) = 0\end{array}}$$

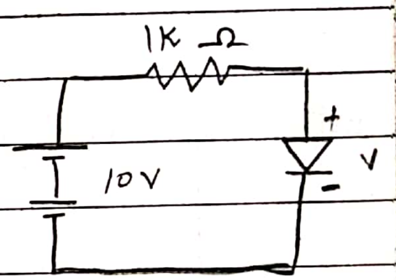
$$-10 + 0.7 + 100\, R_L = 0$$

$$100^{\times 10^{-3}} R_L = 9.3$$

$$R_L = \frac{93}{10 \times 100} \times 1000 = 93\ \Omega$$

Ques Find the current through circuit shown below for which the V-I characteristics of the diode are as follow

$$i = \begin{cases} \dfrac{V_i - 0.7}{500}\ A & V_i \geq 0.7\,V \\ 0\ A & V_i < 0.7\,V \end{cases}$$



$$-10 + \frac{V_i - 0.7}{500} \times 1000 + V = 0$$

$$-10 + 2V_i - 1.4 + V = 0$$

$$3V = 11.4$$

$$V = 3.8\ V$$

$$I = \frac{V - 0.7}{500}\ A = \frac{3.8 - 0.7}{500} = \frac{3.1}{500} = 6.2\ mA$$

$I = 6.2\ mA$

Ques The varactor diode has a property of variable capacitance and it is used in FM radio and TV receivers. If diode has capacitance of value 18pF when V_R across it is 4V. Determine capacitance when biased voltage is double.

$$C_1 = \frac{K}{\sqrt{V_{R_1}}} \qquad V_{R_2} = 2 \cdot V_{R_1}$$

$$C_2 = \frac{K}{\sqrt{V_{R_2}}}$$

$$\frac{C_2}{C_1} = \sqrt{\frac{V_{R_1}}{V_{R_2}}}$$

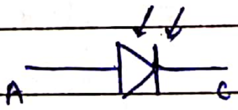
$$\frac{C_2}{C_1} = \sqrt{\frac{1}{2}}$$

$$\frac{C_1}{C_2} = \sqrt{2}$$

$$C_2 = \frac{18}{1.414} pF = 12.72 \ pF$$

Photo Diode :

It is a light sensitive device which converts light signals into electrical signals.



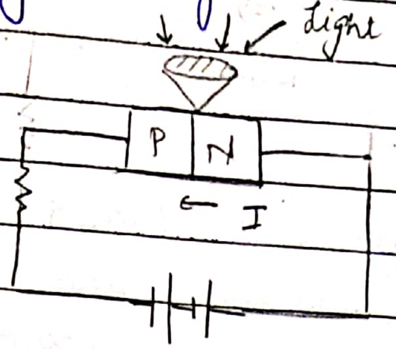
(also known as photo detector)

Functioning -

A lens permit light to fall on the junction. When light falls on $\boxed{\text{reverse biased}}$, p-n photo diode junction, hole - e pairs are created. The movement of these hole - e^- pairs is in properly connected circuit results in current flow. The prod. current is proportional to intensity of

Date: / /
Page:

light falling on junction of diode.



Dark current - When no light is applied, there is a minimum reverse leakage current and this current is known as dark current flowing through device.

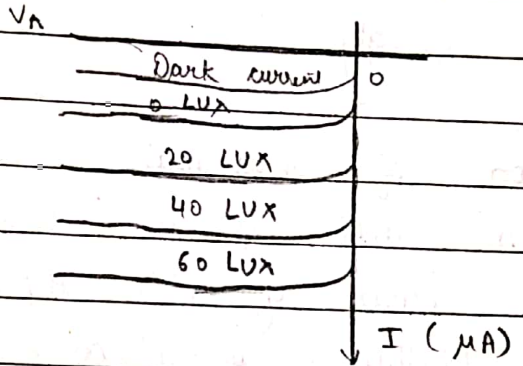
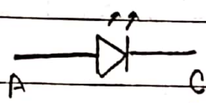


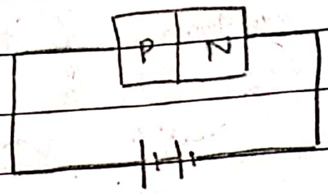
photo diodes are used as light detectors. They are also used in switching circuit.

LIGHT EMITTING DIODE (LED)



LED emits light when it is forward biased.
In all semiconductor p-n junctions, some of energy will be radiated as heat and some will be in the form of photons. In Si and Ge, most of energy is radiated in form of heat and emitted light is insignificant. Therefore Si and Ge cannot be used in LED [heat - 95%, light - 5%]

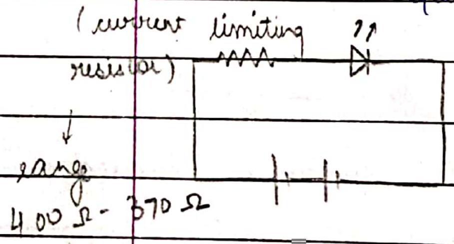
★ The material such as Gallium - phosphite and Gallium - Arsenic - phosphite (composite material) have large no. of photons of light energy emitted which is sufficient to create visible light source [Heat - 10% light:- 90%]



Working.
When LED is forward biased, the e^- and holes moves towards junction and recombination takes place. As a result of recombination, the e^- lying in conduction band of n-region fall into holes lying in valence band of p-region. The difference of energy b/w cond. band and V-B is radiated in form of light energy

Classification of material
LED radiate diff colours such as red, green, orange, white. The colour of LED depends on type of material.

Gallium phosphide - Red or green
Gallium arsenic phosphide - Yellow
Gallium arsenide - Infrared.

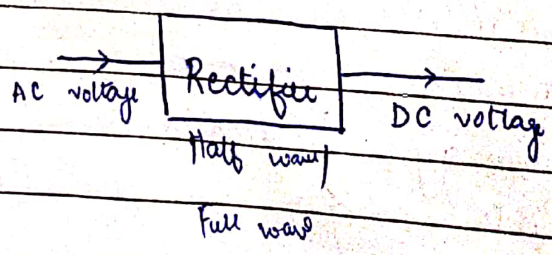


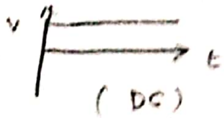
Resistor to prevent damage by reducing current.

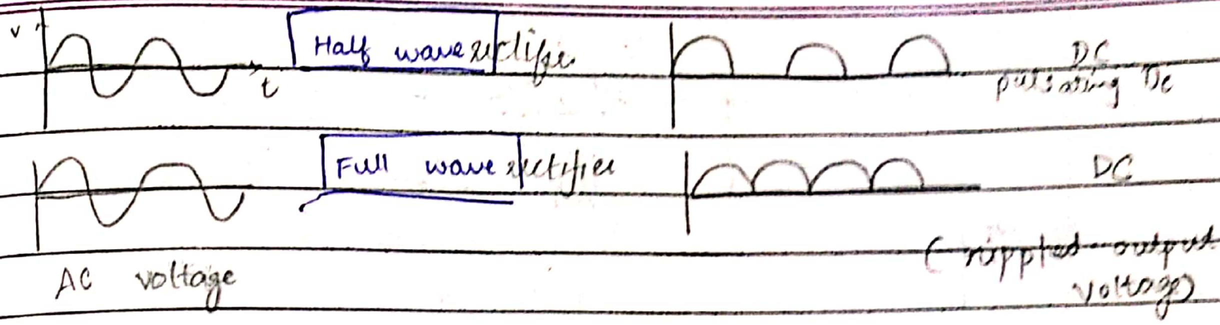
RECTIFIERS...

Rectifier is a device which converts AC to DC

Bidirectional Voltage → Unidirectional voltage.

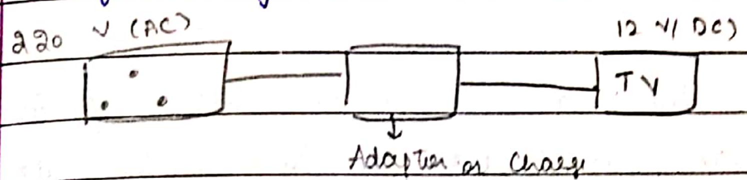


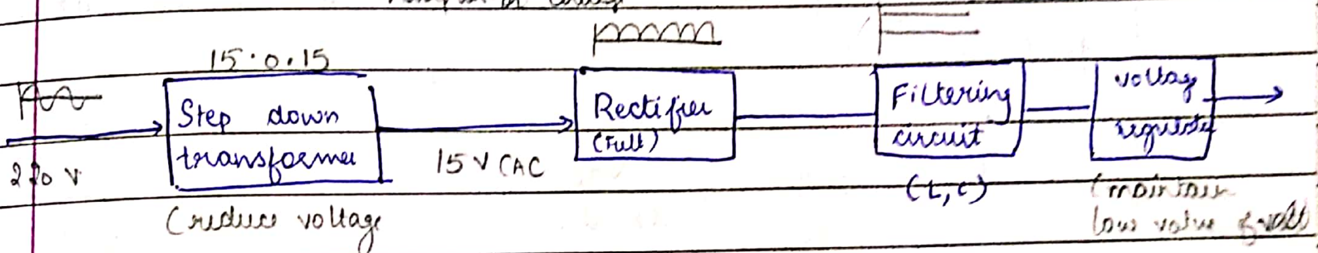




Use

Cellfone charger

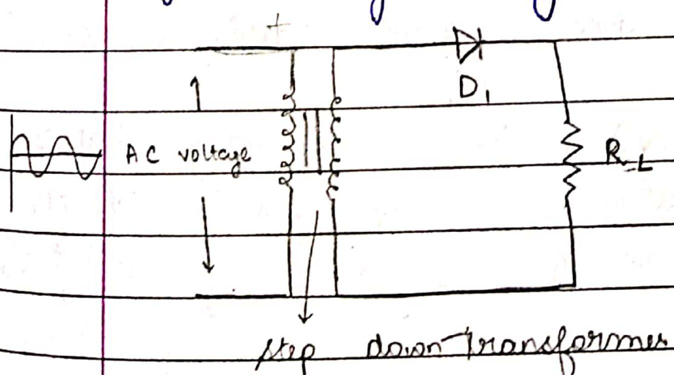




A half wave rectifier converts AC voltage into pulsating DC voltage using only one half of applied AC voltage. The diode conducts during one half of AC cycle only

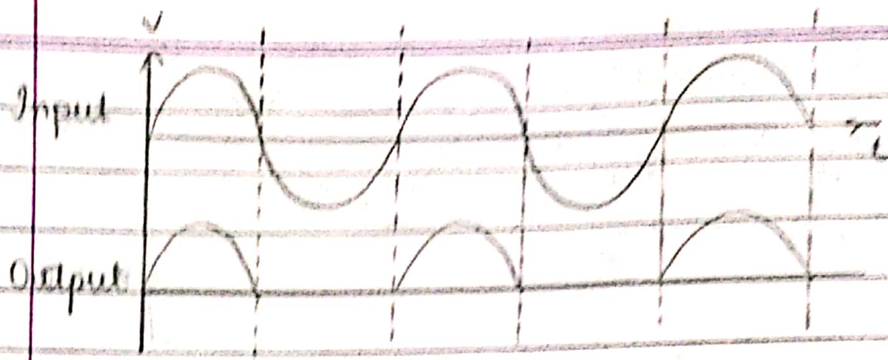
D_1 → PN Junction diode

R_L → load resistor.



During +ve half cycle – Diode will be forward biased so conduct voltage

During –ve half cycle – Diode will be reverse biased so donot conduct



$\boxed{V_i = V_m \sin\omega t}$

Ripple factor - The ratio of rms value of AC component to DC component in output is known as ripple factor (Γ)

$$\Gamma = \frac{V_{rms}}{V_{dc}} = \frac{V_{ac}}{2 \times V_{dc}}$$

Efficiency (η) - Ratio of DC output power to AC input power is known as rectifier efficiency.

$$\% \eta = \frac{P_{dc}}{P_{ac}} \times 100$$ (How much DC is converting from AC)

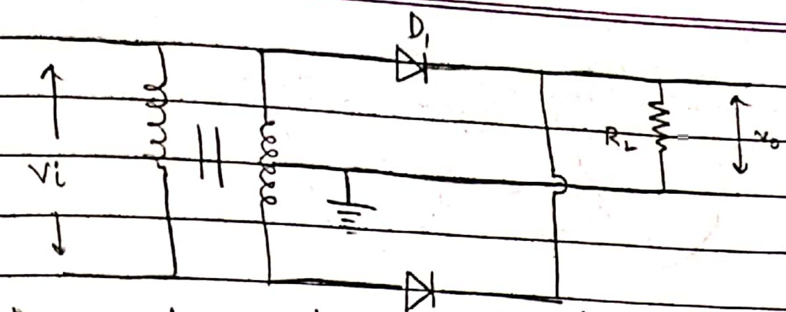
$$\boxed{\eta = \frac{40.6}{1 + \frac{R_d}{R_L}}}$$

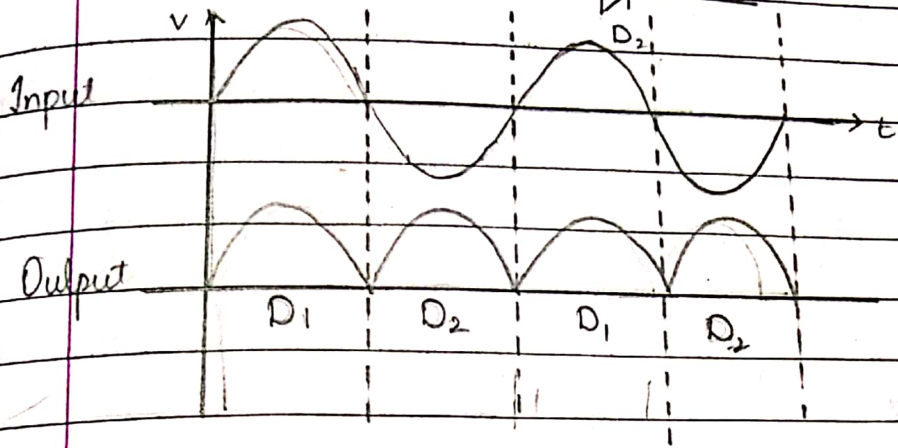
In case of HWR, max efficiency is 40.6%
ripple factor is 1.21

Peak Inverse Voltage (PIV) - Max reverse voltage that a diode can withstand without destroying junction. The PIV across a diode is peak of -ve half cycle is V_m

FULL WAVE RECTIFIER

(1) Centre tap full wave rectifier converts AC voltage into pulsating DC voltage and it conducts for +ve half cycle as well as -ve half cycle of AC input voltage.





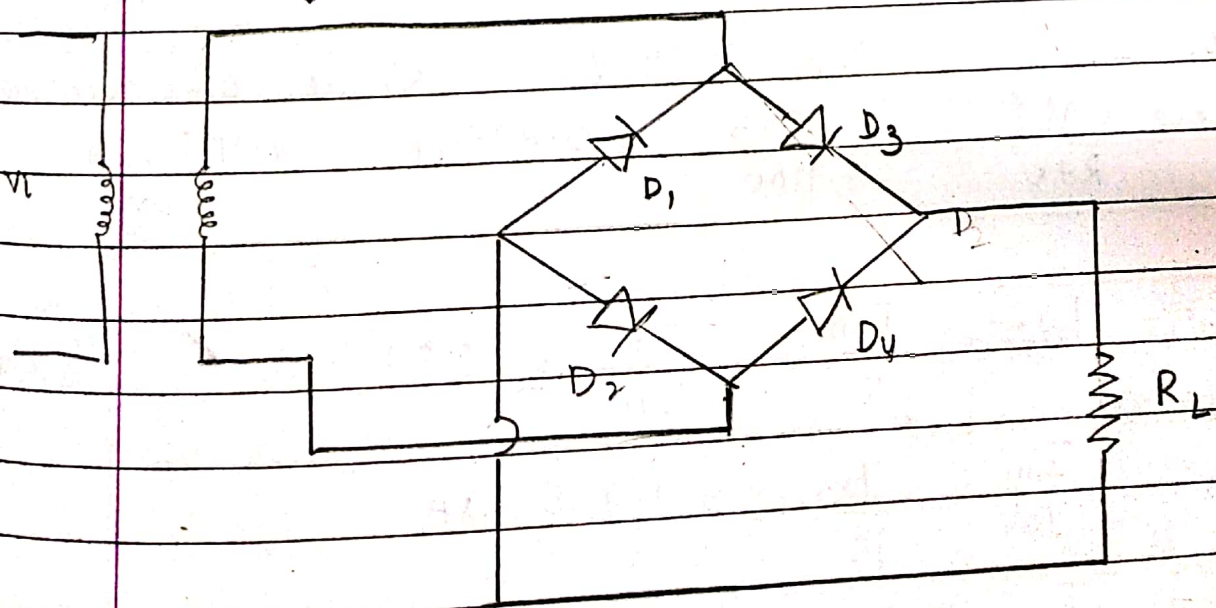
The centre tap FWR requires centre tap transformer and this transformer makes it bulky

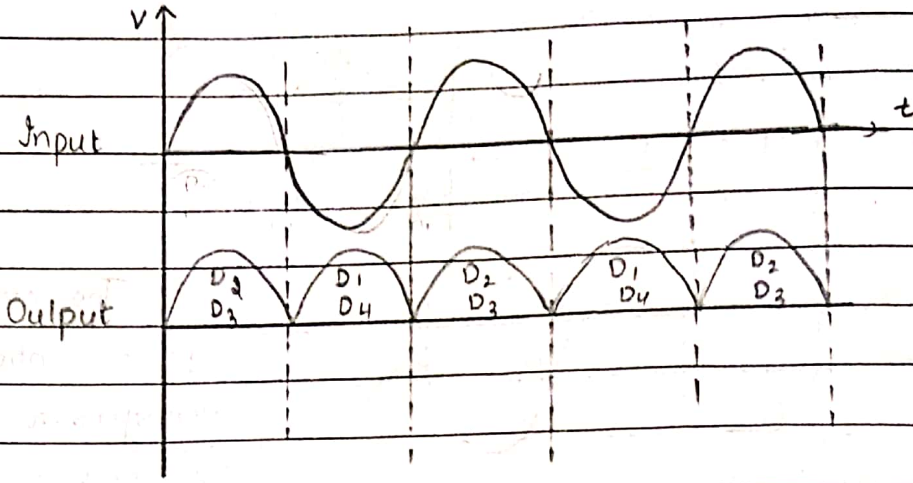
Full wave rectifier has max. effeciency 81.2%.

Ripple factor $\Gamma = 0.482 = \frac{V_{rms}}{V_{dc}}$ ($\Gamma \downarrow$ ~~more~~ better)

$PIV = 2V_m$

(2) Bridge rectifier





$PIV = V_m$

$\eta = 81.2\%$

$\Gamma = 0.482$

Ques A half wave rectifier having resistance load of 1000 Ω rectifies an alt. voltage of 325 V (peak value) and diode has forward resistance of 100 Ω. Calculate (a) Peak, Average, rms value of current
(b) DC power output
(c) AC input power
(d) effeciency of rectifier

(a) $R_L = 1000\ \Omega$ $V_m = 325\ V$ Diode resistance (r) $= 100\ \Omega$

I_m (peak) $= \frac{V}{R+r} = \frac{325}{1100} = 0.2954 A = 2.95\ mA$

$I_{av.} = I_{dc} = \frac{I_m}{\pi} = \frac{I_m}{3.14} = 0.09409 = 0.94\ m\cancel{A}$

(Half wave) $I_{rms} = \frac{I_m}{\sqrt{2}} \cancel{\frac{I_m}{\sqrt{2}}} = \frac{I_m}{\sqrt{2}} = 1.475\ mA$

(b) $P_{dc} = I_{dc}^2 \times R_L = 8.84 W$

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Date : / /
Page :

(c) $P_{ac} = (I_{rms})^2 \times (r_f + R_L)$
$= 24 W$

(d) $\eta = \frac{P_{dc}}{P_{ac}} \times 100 = \frac{8.84}{24} \times 100 = 36.85\%$

Ques A half wave rectifier is used to supply 24 V dc to resistive load of 500 Ω and diode as a forward resis. of 50 Ω. Calculate max value of ac voltage ~~as~~ req. at input

Ans $V_{dc} = 24V$ $R_L = 500\,\Omega$ $r = 50\,\Omega$

$I_{ac} = \frac{V}{500+50}$

$I_{dc} = \frac{I_{ac}}{\pi} = \frac{V_{dc}}{R_L}$

@rajat_kansal

$I_{dc} = \frac{24}{500} = \frac{I_{ac}}{\pi}$

$\frac{24}{500} = \frac{V_{ac}}{(R+r)\pi}$

$V_{ac} = \frac{24}{\cancel{500}\,10} \times \cancel{550}\,11 \times 3.14 = 82.89 V$

Ques A full wave rectifier delivers 50 W to load of 200 Ω. If ripple factor is 1%. Calculate ac ripple voltage across the load

(output) $P_{dc} = 50$ $R_L = 200\,\Omega$ $\Gamma = \frac{V_{rms}}{V_{dc}} = 1$

$P_{dc} = \frac{V_{dc}^2}{R_L}$ $V_{dc}^2 = 50 \times 200 = 10000$

$V_{dc} = 100 V$

$\cancel{V_{dc} \times \pi = \frac{V_{ac}}{V_{ac^2}} \; 100 \times 3.14 \; 3.14}$

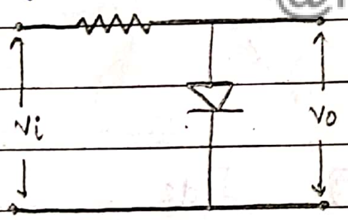
$\cancel{\frac{V_{ac}}{V_{rms}}}$ $\frac{V_{rms}}{V_{dc}} \times 100 = 1$

$\frac{V_{rms}}{100} \times 100 = 1$

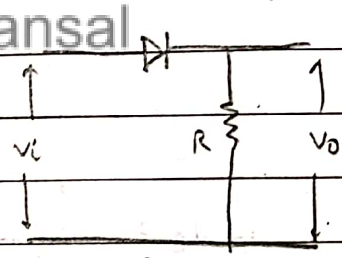
$\boxed{V_{rms} = 1\,V}$

DIODE CLIPPERS

The circuit with which wave form is shaped by removing or clipping a portion of input signal without destroying remaining part is called a clipper.
Clipping circuits are also known as voltage or current limiters, Amplitude selectors and slicers.
Clipping circuits use diode, resistor, battery

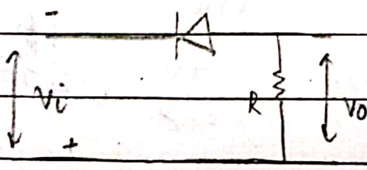


Parallel

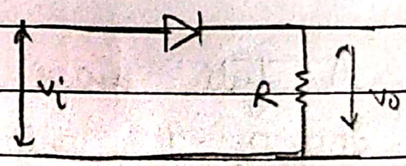


Series

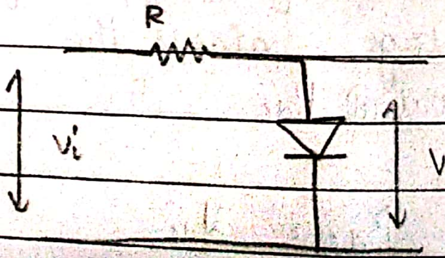
Positive clipper - In series



Negative clipper

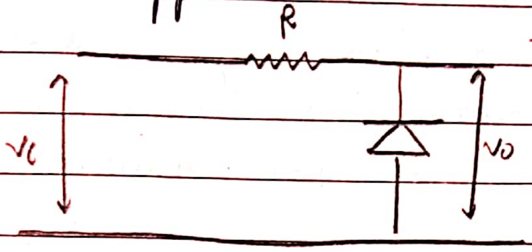


Positive parallel clipper



When input voltage is +ve, diode conducts and it acts as short circuit and voltage across 2 ends of diode will be 0. Hence output voltage will be zero. During -ve half cycle diode will be reverse biased. So it will be open circuit so whatever we are giving at input that will appear across output

-ve parallel clipper



An AC supply of 230V is applied to half wave rectifier through a transformer turns ratio 5:1 Assume the diode is an ideal diode. The load resistance is 300 Ω. Find :

(a) DC output voltage ② Peak Inverse voltage
③ Max val. of load current ④ Av value of load current
⑤ DC power supply

$V_{ac} = 230\ V$ $\quad R_L = 300\ \Omega$

$\frac{V_{ac}}{V_{rms}} = \frac{5}{1} \Rightarrow V_{rms} = \frac{230}{5} = 46\ V$

$V_m = 46\sqrt{2}\ V$

(b) $PIV = 46\sqrt{2}\ V$

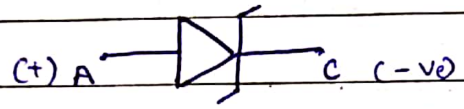
$V_{dc} = \frac{V_m}{\pi} = \frac{46\sqrt{2}}{\pi}$

(c) $I_{DC} = I_{av} = \frac{46\sqrt{2}}{\pi\ (300)}$

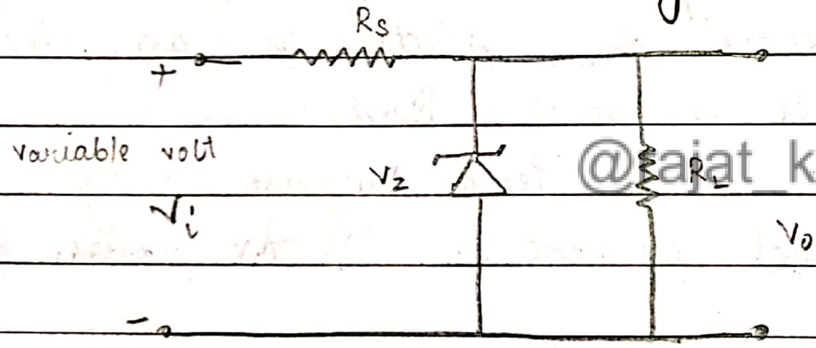
(d) $P_{dc} = I_{dc}^2 \times R_L$

Zener Diode

When reverse voltage reaches breakdown voltage in normal p-n junction diode, then current through junction and power dissipated at junction will be high. Such an operation is destructive and diode gets damaged. whereas diodes can be designed with sufficient power dissipation capabilities to operate in breakdown region. Such a diode is called zener diode. Zener diode is heavily doped in comparison to p-n diode.

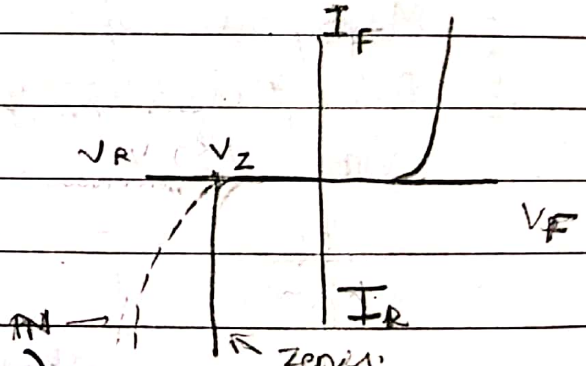


Zener diode as voltage regulator



R_S – Series resistance

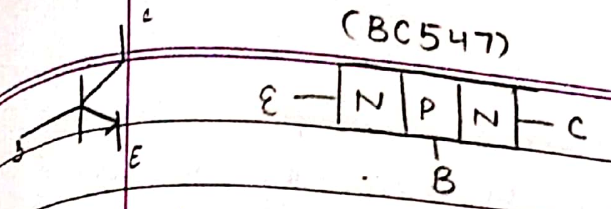
R_L – load resistance



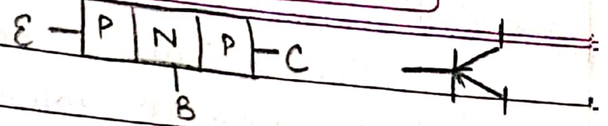
BJT (Bipolar Junction Transistor)

A BJT is a 3 terminal (EBC) semiconductor device in which operation depends on interaction of both majority and minority carriers. BJT is used in amplifier and oscillator circuits and also used as a switch in digital circuit

(BC547)



(BC557)

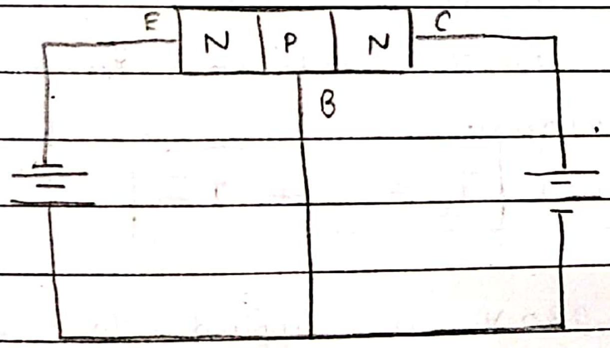


A BJT consist of a silicon or Germanium crystal in which a thin layer of N-type is sandwitch between two layers of P-type Silicon. This transistor is known as P-N-P transistor.

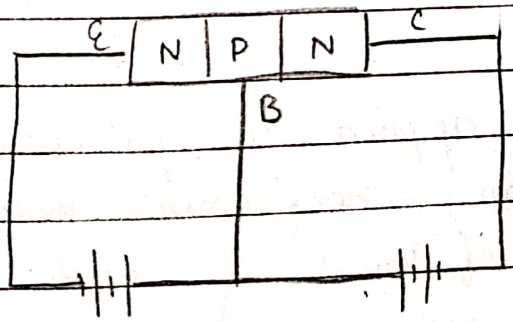
- ↳ The emitter is heavily doped, so that it can inject a large number of charge carriers into base
- ↳ The base is lightly doped and very thin. It passes most of injected charge carriers from emitter to collector
- ↳ The collector is moderately doped

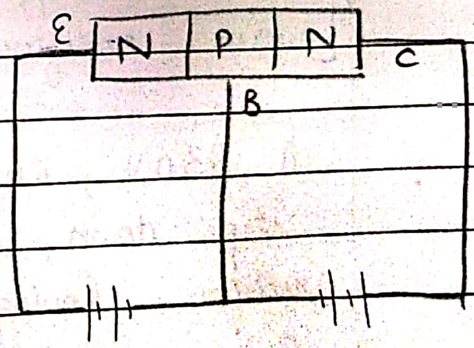
In case of transistor, arrow of emitter terminal indicates direction of conventional current.

TRANSISTOR BIASING : → to supply power (either forward or reverse)



EB Junction → Forward
BC Junction → Reverse
(Active Mode) → use for amplifier

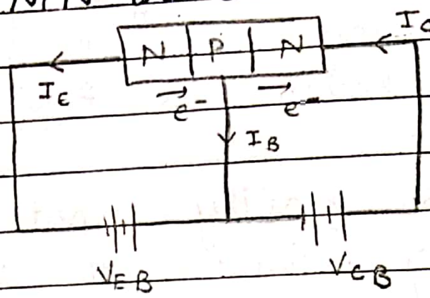




Both forward (Saturation Mode) → used as switch ← (Cut-off Mode) Both reverse

When to use transistor as ~~stted~~ switch, operate transistor in saturation mode or cut-off mode

Working of NPN transistor



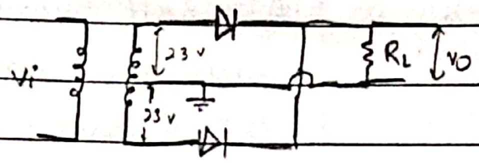
As emitter base junction is forward biased, it causes a lot of $\bar{e}$ from emitter region to cross over to base region. As base is lightly doped with p-type impurity therefore no. of holes in p-type region are very small. Hence a few no of $\bar{e}$ combine with holes to constitute base current I_B. The remaining $\bar{e}$ cross over into collector region to constitute collector current I_C. More than 95% $\bar{e}$ pass over from emitter region to collector region. Only 5% $\bar{e}$ injected from emitter region combine with holes in p-type region.

The emitter current $\boxed{I_E = I_B + I_C}$

× [An AC supply of 230 V is applied to half wave rectifier]

A 230 V, 60 Hz is applied to primary of 5:1 step down, centre tap transformer used in full wave rectifier having a load of 900 Ω. If diode resistance and secondary coil resistance together has value of 100 Ω. Determine

(a) dc voltage across load
(b) dc current through load.
(c) dc power delevierd to load
(d) peak inverse voltag (PIV)
(e) ripple voltage and its fequency



CT

$v_i = 230\,V$ $\nu = 60\,Hz$ $N_P/N_S = \frac{5}{1}$ $R_L = 900\,\Omega$

(a) $\boxed{V_{dc} = \frac{2V_m}{\pi}}$

$$\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{5}{1}$$

$$V_S = \frac{230}{5} = 46\,V$$

$$V_{rms} = 23\,V$$

$$V_m = 23\sqrt{2}$$

$$V_{dc} = \frac{2 \times 23 \times 1.413}{3.14} = 20.71$$

(b) $$I_{dc} = \frac{V_{dc}}{R_L + R_d} = \frac{20.71}{900 + 100} = \frac{20.71}{1000} = 20.71\,mA$$

(c) $$P_{dc} = I_{dc}^2 \times R_L$$
$$= 20.71 \times 20.71 \times 900$$

(d) $$PIV = 2V_m$$
$$= 2 \times 23 \times 1.414 = 46 \times 1.414$$

(e) Ripple factor $= \sqrt{(V_{rms})^2 - (V_{dc})^2}$

(f) fequency $= 2f$

Date : / /
Page :

Q. A half wave rec. has load of 3.5 kΩ. If diode resistance and sec. coil resistance together have value of 800 Ω then calculate rectifier efficiency

Ans
$$\eta = \frac{40.6}{1 + \frac{r_d}{r_L}} \%$$

$$= \frac{40.6}{1 + \frac{800}{3500}}$$

$$= \frac{\cancel{40.6}^{203} \times \cancel{35}^{7}}{43 \times \cancel{10}_{2}} \%$$

$$= \frac{1421}{43} \% = 33.04 \%$$

The turns ratio of a transformer used in half wave rectifier is 12 : 1. The primary is connected to 220 V, 50 Hz supply. Assume that forward resistance of diode is 0. Calculate PIV of diode.

$$\frac{N_1}{N_2} = \frac{V_1}{V_2}$$

$$\frac{12}{1} = \frac{220}{V_2}$$

$$V_2 = \frac{220}{12} = \frac{110}{6}$$

$$V_{rms} = \frac{110}{6}$$

$$V_m = \sqrt{2}\ V_{rms}$$

$$PIV = \cancel{2}\ V_m = \cancel{2} \times \frac{110}{\cancel{12}\ 6} \times \sqrt{2} = \frac{110 \times 1.414}{6}$$

$$= 25.9$$

Date : / /
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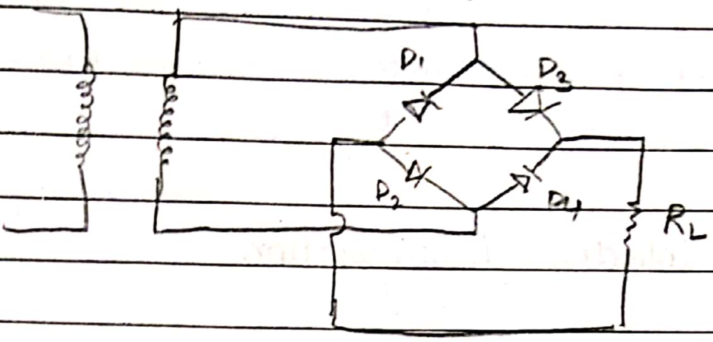
Ques It is desire to obt. max of 15 V Dc from bridge rectifier circuit. It uses Si diodes (voltage drop across each si diode is 0.7 V) Across primary of step down transformer a supply of 220 V, 50 Hz is given. Find turns ratio of transformer.



$V_{dc} = \frac{2V_m}{\pi}$

$V_m = \frac{15 \times 3.14}{2} = 15 \times 1.57 = \cancel{16.05}\ 23.55$

Total $V_m = \cancel{23.05 + 0.7 \times 2}\ 23.55 + 0.7 \times 2$

$23.55 + 1.4 = 24.95$

@rajat_kansal

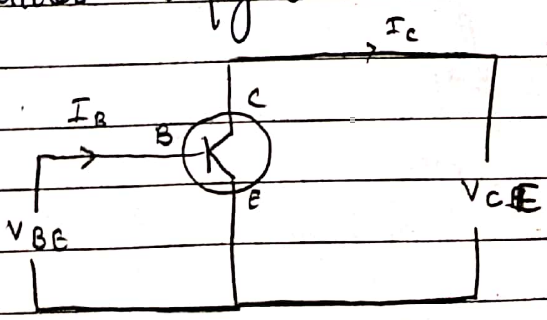
$V_{rms} = \frac{V_m}{\sqrt{2}} = 17.64$

$\frac{N_1}{N_2} = \cancel{\frac{15}{16}}\ \frac{220}{17.64} = \frac{12.5}{1}$

TRANSISTOR CONFIGURATION

Common Emitter Configuration

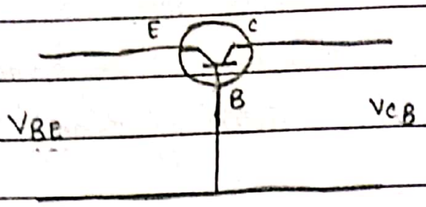
Input volt = V_{BE}
Output vol = V_{CE}
Input current = I_B
Output current = I_C



Current gain $(\beta) = \frac{I_C}{I_B}$

$\beta \geq 1$

Common Base Configuration

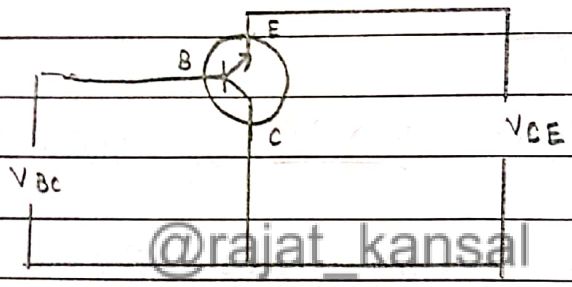


Input voltage = V_{BE}
Output voltage = V_{CB}
Input current = I_E
Output current I_C

Current gain = $\frac{\text{Output current}}{\text{Input current}}$

Current gain (α) = $\frac{I_C}{I_E}$

Common Collector Configuration



Input voltage = V_{BC}
Output voltage = V_{CE}
Input current = I_B
Output current = I_E

Current gain (γ) = $\frac{I_E}{I_B}$

Formulas

$I_E = I_B + I_C$

$I_b = \frac{I_E}{1+\beta}$

$\alpha = \frac{I_C}{I_E}$

$\beta = \frac{I_C}{I_B}$

$\beta = \frac{\alpha}{1-\alpha}$

$\alpha = \frac{\beta}{\beta+1}$