unit-03.→

Transistor as a Switch.

* A trans is used for Switch operation for opening or closing of a Circuit.

* In another word, it can say that a transistor is used as ON Switch and OFF Switch.

* In the ON Condition transistor allow to flow the Current through the Circuit and in the OFF Condition transistor do not allow to flow the Current through the Circuit. And is the OFF condition.

* Both n-p-n and PNP transistor Can be used as Switch.

* There are following two Operating mode of transistor Switch.

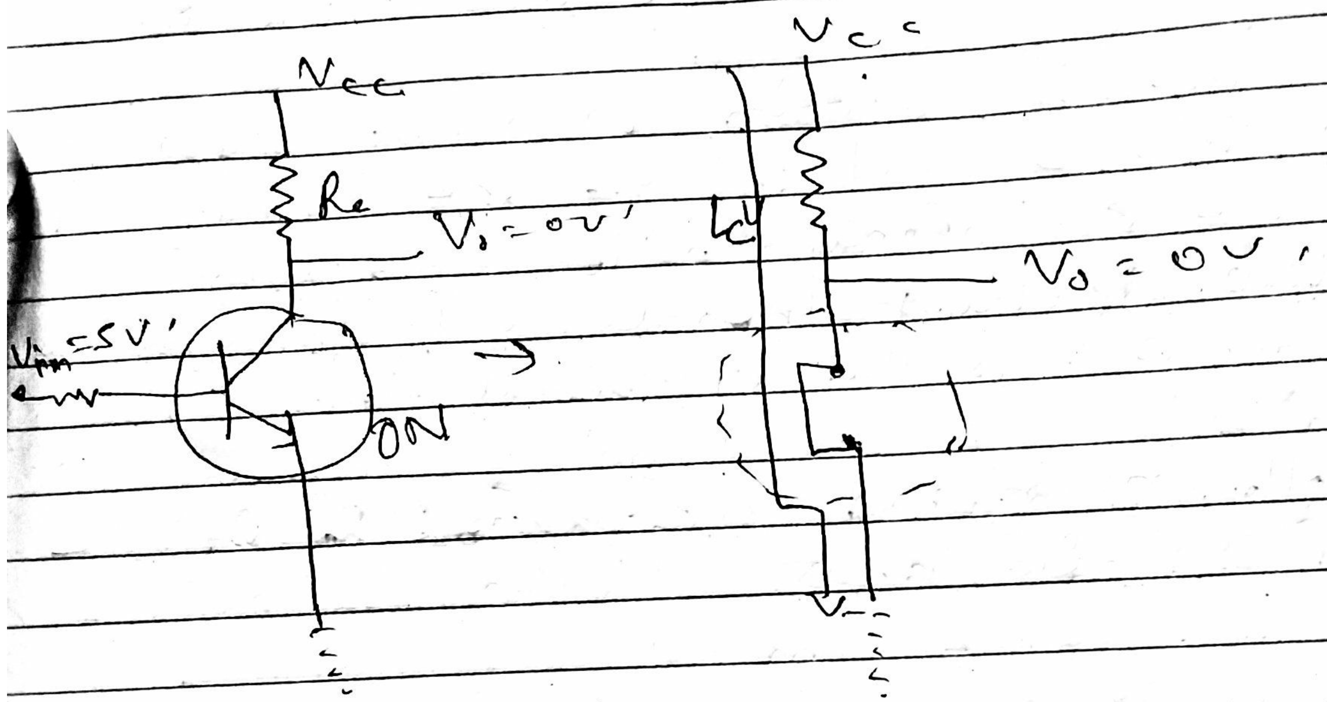
(a) Transistor as a Switch - ON

* Based on the voltage applied at the base terminal of a transistor Switching Operation is performed.

* Let us Consider as NPN transistor for Switching Operation.

* When sufficient input voltage ($V_{in} > 0.7V$) is applied between them transistor become turn-ON. In this case the Collector-Emitter voltage V_{CE} approximately equal to zero i.e. transistor act as Short Circuit.

Collecter Current $I_C = \frac{V_{CC}}{R_C}$.

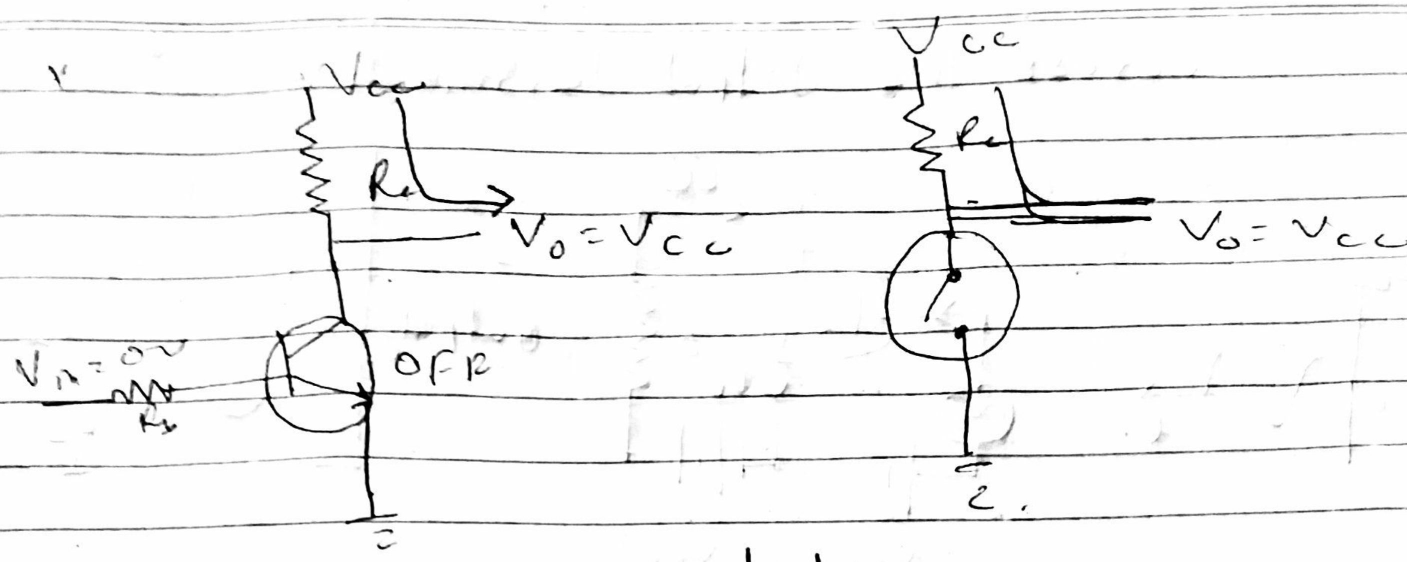


(b) Transistor As a Switch-Off

When the input voltage at base is less than 0.7V or 0V the transistor is a Cutt off mode.

Then no Current flow through V_{CC} too Ground because Transistor work as a Open Switch.

The total Voltage available at the Collecter.



* If Load or output is LED bulb then its light glow.

* If LED bulb Connected with Collector terminal LED light it not glow.

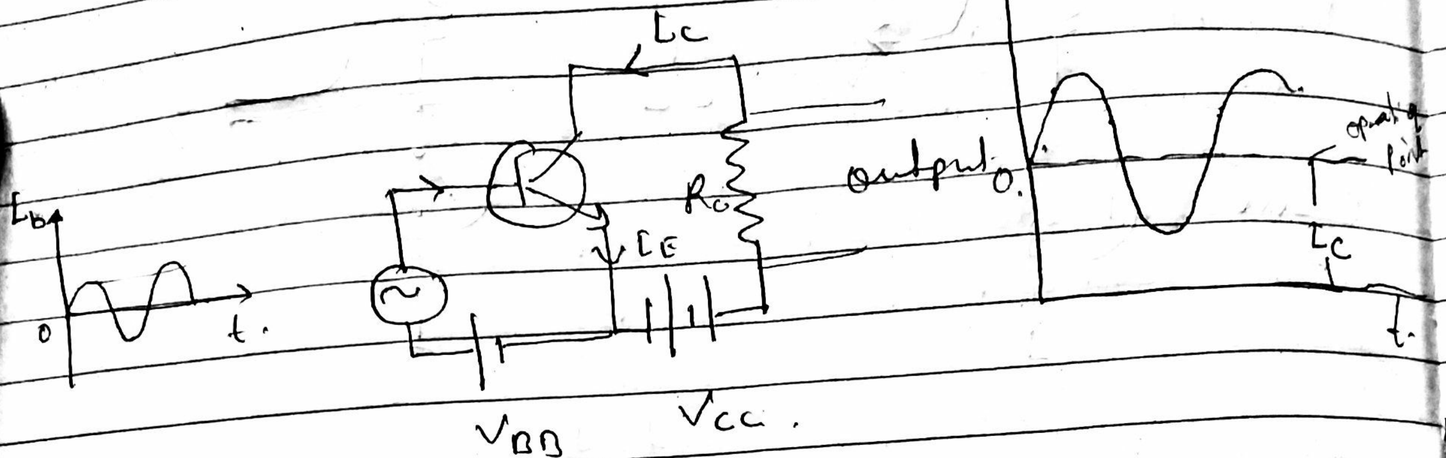
Transistor as an amplifier.

* A Transister is work as an amplifier: when transister work in active region.

* When a transistor work as an amplifier then it amplify the weak Signal applied at the input Signal.

* In this working Condition the weak Signal is applied at the input terminal and the amplified output is obtained

across the Output terminals.



Analysis of Collecter Current:→
When no Signal is applied the input Circuit is forward biased by the battery V_{BB}. Therefore, a d.c Collecter Current I_C flows in Collecter Circuit. This is called "Zero Signal Collector Current".
When the Signal Voltage applied, the forward bias on the emitter base junction increases or decreases depending upon whether the Signal is positive or negative.
During the +ve half Cycle of the Signal, the forward bias on Emitter-base junction is increased, Causing total Collecter Current I_C to increase. Reverse will happen in -ve half Cycle.
From the given graph,
Total Collecter Current Consist of two Comp

i) The d.c Collector Current I_c due to bias battery V_{BB}. This is the collector Current wich flow the absence of Signal

(ii) The a.c Collector Current i_c due to Signal.

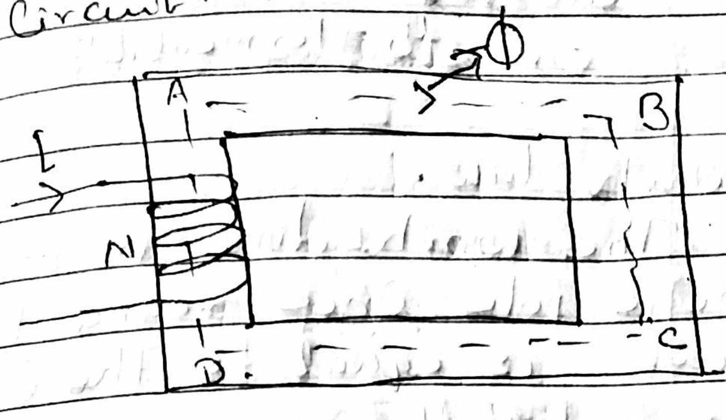
∴ Total Collector Current i_c due to Signal.

∴ Total Collector Current (i_C)

$= i_c + I_c$.

Magnetic Circuits.

Magnetic Circuit :→ The closed path followed by magnetic flux is called a magnetic circuit.



i) The amoun of magnetic flux set up in the core depends upon current "I" and numbers of turns "N"

The product NI is called magneto motive force (m.m.f.)

m.m.f = N·I amperes turn.

(ii) The opposition that the magnetic circuit offers to the magnetic flux is called reluctance

Analysis of magnetic circuit.

Magnetic flux density in the material

$B = \frac{\phi}{a}$

where "a" ⇒ cross section area of the core

ϕ = magnetic flux.

Magnetic force in the material $= H = \frac{B}{\mu_0 \mu_r} = \frac{\phi}{a \mu_0 \mu_r}$.

where μ_0 = Permeability of air

μ_r = Permeability of core material

According to work law.

The work done in moving a unit magnetic pole once round the magnetic circuit is equal to the ampere-turns enclosed by the magnetic circuit.

$$H \times l = NI$$

where l = length ABCDA in figure.

$$\frac{\phi}{\mu_0 \mu_r} \times l = NI$$

$$\boxed{\phi = \frac{NI}{l / a \mu_0 \mu_r}}$$

Magnetic flux ← $\boxed{\phi = \frac{\text{m.m.f}}{\text{Reluctance}}}$

Important terms

(i) flux :→ The amount of magnetic field produced by a magnetic source is called magnetic flux. denoted by "ϕ"

The SI unit of magnetic flux is weber

$$1\ wb = 10^8 \text{ lines}$$

(ii) Magnetomotive force (m.m.f) :→

It is magnetic pressure which setsup or tends to set up magnetic flux in a magnetic circuit.

Define in another way

The work done in moving a unit magnetic pole once round the magnetic circuit is called m.m.f.

$$m.m.f = NI \text{ ampere turns (AT)}$$

(iii) Relucterence :→ The opposition that the magnetic circuit offers to magnetic flux. is called reluctance.

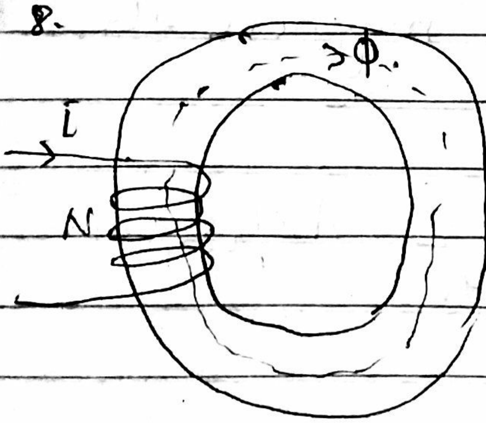
$$\text{Reluctance, } S = \frac{l}{a\mu_0\mu_r} \quad AT/wb \text{ (unit)}$$

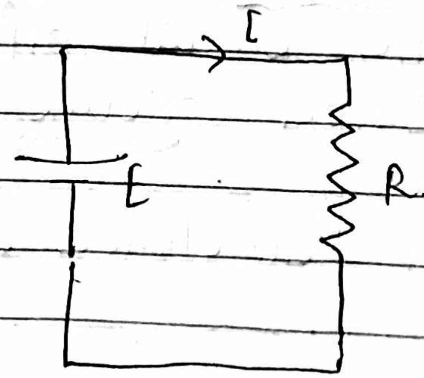
Comparision between Magnetic and Electric Circuit.

Similarities.

Magnetic circuit	Electric circuit
1. The closed Path for magnetic flux is Called a magnetic Circuit.	1. The closed Path for electric Current is called an electric Circuit.
2. Magnetic flux, $\phi = \frac{m.m.f}{Reluctance}$	2. Current $I = \frac{e.m.f}{resistance}$.
3. m.m.f (AT)	3. e.m.f (volts)
4. Reluctance, $S = \frac{l}{a \mu_0 \mu_r}$	4. Resistance $R = \rho \frac{l}{a}$
5. Magnetic flux density $= B = \frac{\phi}{a}$ wb/m²	5. Current density, $J = \frac{I}{a}$ A/m²
6. m.m.f drop $= \phi \cdot S$.	Voltage drop $= IR$.
7. Magnetic intensity, $H = NI/l$.	7. Electric intensity $E = V/d$.

8.





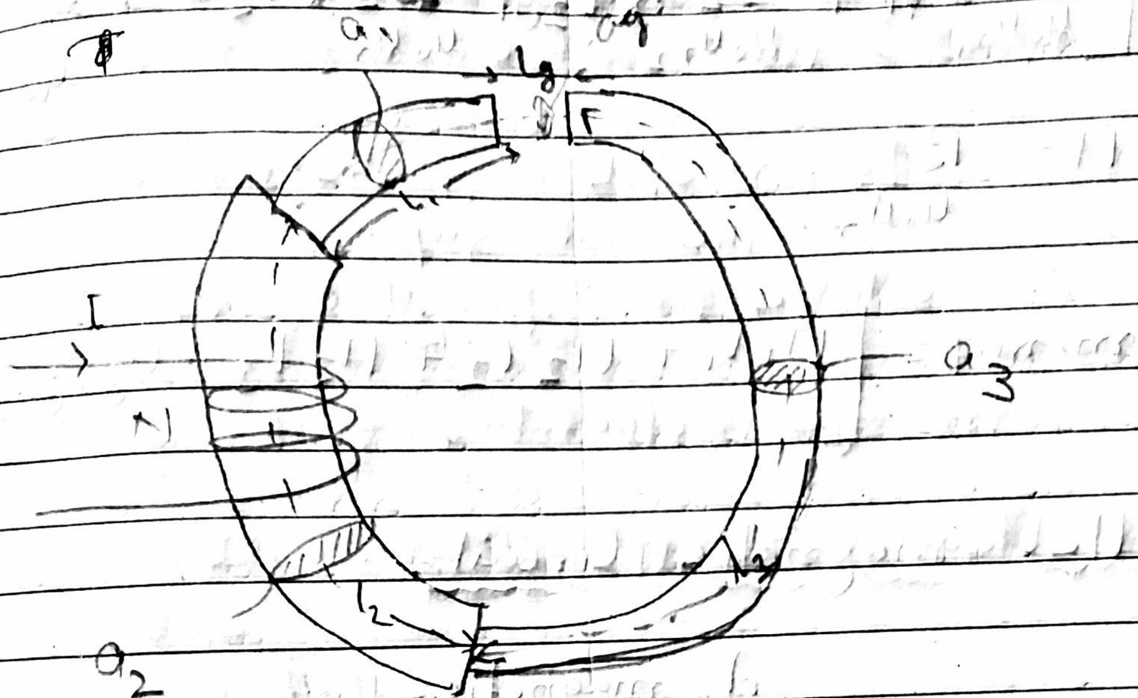
Dissimilarities

1. Truly speaking "magnetic flux does not flow" (assumption)	1. The electric current actually flows in an electric circuit.
2. There is no magnetic insulator. (ex → magnetic flux flow in air also.)	There are a number of electric insulators. air is very good insulator and current can't pass through it.
3. The value of μ_r is not constant for a given magnetic material. It varies considerably with magnetic flux density (B) in the material. Reluctance of magnetic circuit is not constant rather its depends upon B	3. The value of resistivity (ρ) varies ~~very~~ slightly with temperature. Therefore, the resistance of electric circuit is practically constant. Resistance of electric circuit is constant.
4. No energy is expended in magnetic circuit. In another word, energy is required in creating in magnetic flux and not it maintaining it.	When current flows through an electric circuit, energy is expended so long as the current flows. The expended energy is dissipated in the form of heat.

Composite Magnetic Circuit (Series magnetic Circuit)

A Series magnetic Circuit that has part of different dimensions and materials is called Composite magnetic Circuit.

Total reluctance is equal to the sum of reluctance of individual parts.



$$\text{Total reluctance} = \frac{l_1}{a_1 \mu_0 \mu_{r_1}} + \frac{l_2}{a_2 \mu_0 \mu_{r2}} + \frac{l_3}{a_3 \mu_0 \mu_{r3}} + \frac{l_g}{a_g \cdot \mu_0}$$

Total m.m.f = magnetic flux x Total reluctance

$$= \phi \left[\frac{l_1}{a_1 \mu_0 \mu_{r_1}} + \frac{l_2}{a_2 \mu_0 \mu_{r2}} + \frac{l_3}{a_3 \mu_0 \mu_{r3}} + \frac{l_g}{a_g \mu_0} \right]$$

$$= \left[\frac{\phi}{a_1 \mu_0 \mu_{r_1}} \times l_1 + \frac{\phi}{a_2 \mu_0 \mu_{r_2}} \times l_2 + \frac{\phi}{a_3 \mu_0 \mu_{r_3}} \cdot l_3 + \frac{\phi}{a_g \mu_0} \times l_g \right]$$

$$\because B = \frac{\phi}{a}$$

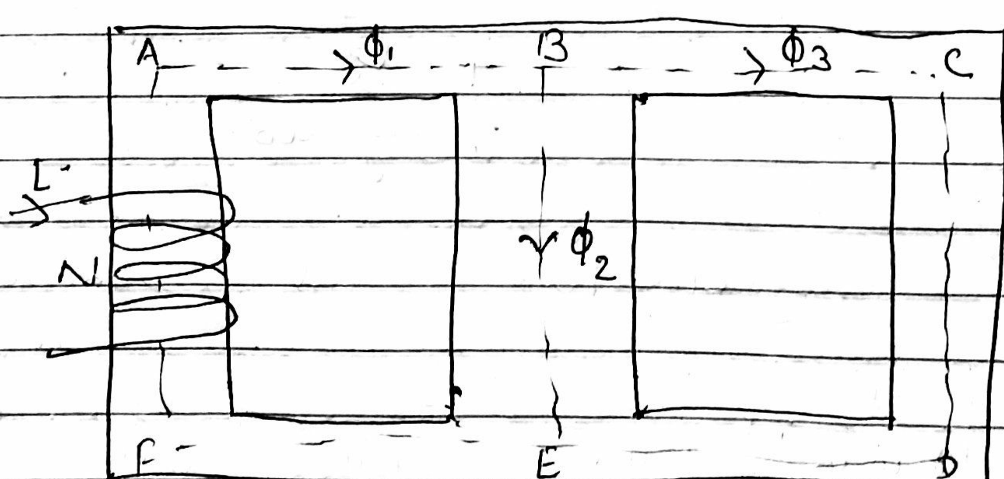
$$\therefore = \left[\frac{B_1}{\mu_0 \mu_{r_1}} \times l_1 + \frac{B_2}{\mu_0 \mu_{r_2}} \times l_2 + \frac{B_3}{\mu_0 \mu_{r_3}} \times l_3 + \frac{B_g}{\mu_0} \times l_g \right]$$

$$\because H = \frac{B}{\mu_0 \mu_r}.$$

$$\therefore \text{m.m.f} = \left[H_1 l_1 + H_2 l_2 + H_3 l_3 + H_g l_g . \right]$$

Parallel magnetic Circuits.

A magnetic Circuit which has more than one Path for magnetic flux is called a Parallel magnetic Circuit.



The magnetic flux that does not follow the desired path in a magnetic circuit is called leakage flux.

Let,

ϕ_i = total magnetic flux produced, i.e magnetic flux in the iron ring.

ϕ_g = useful magnetic flux across the air gap.

∴ leakage flux $\phi_{leak} = \phi_i - \phi_g$.

~~leakage co-efficient, $\phi_{leak} = \phi_i - \phi_g$~~

leakage co-efficient, $\lambda = \dfrac{\text{Total magnetic flux}}{\text{Useful magnetic flux}}$

$$= \frac{\phi_i}{\phi_g}.$$