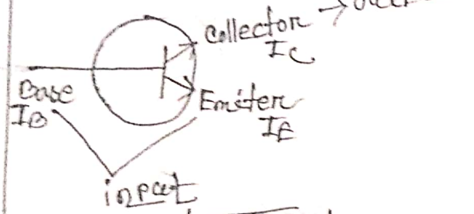
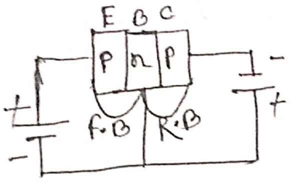
*29-01-19

*Transistor: Transistor consist of two pn Junction formed by Sandwiching either p-type or n-type Semiconductor between a pair of opposite type

① pnp transistor.

② npn transistor.





Structure of Transistor:-

Symbol of Transistor:-

$\therefore I_E = I_B + I_C$

⇒ Transistor use to convert low resistance to high resistance. In 1948 J. Bardeen and W.H Brattain invented Transistor.

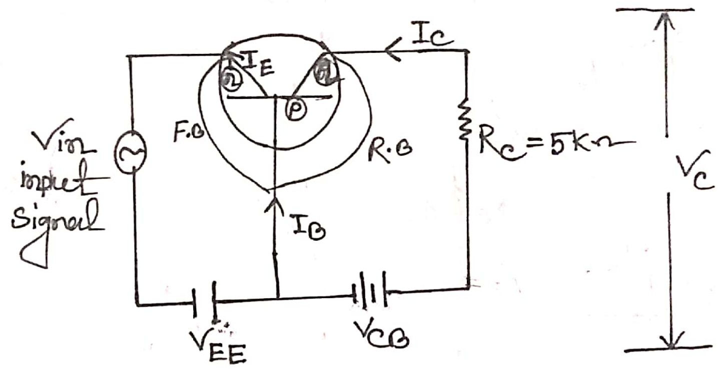
(i) Emitter: Emitter is highly doped and charge carrier is used to inject

(ii) Base: Base is less doped.

(iii) Collector: Collector is moderately doped

* 05.02.19

Transistor as an amplifier: Transistor rises the streanth of weak signal into higher Signal and it's acts as an amplifier.



Suppose,

$V_{in} = 0.1v$, $R_c = 5k\Omega$

$I_c = 1mA$

$V_c = I_c R_c$

$= 1mA \times 5k\Omega$

$= 5v$

$\therefore$ Voltage amplification $= \frac{V_o/V_c}{V_{in}}$

$= \frac{5}{0.1}$

$= 50$

*Math problem:

A common base Transistor amplifier has an input resistance of 20Ω and output resistance of 100kΩ. The collector lode is 1kΩ. If a Signal of 500mv is applied between Emiter and Base. Find the voltage amplifilication. Assume α_{ac} to be nearly one.

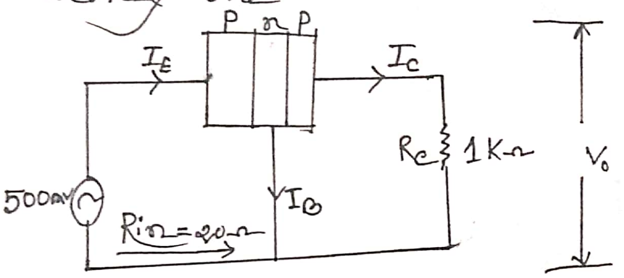


Fig-1:

Soln:

$V_{in} = 500\,mv$

$R_{in} = 20\,Ω$

$V_{in} = I_E R_{in}$

$\therefore I_E = \frac{V_{in}}{R_{in}}$

$= \frac{500\,mv}{20\,Ω}$

$= 25\,mA$

$\therefore$ current amplification, $\alpha = \frac{I_C\ (output)}{I_E\ (input)}$

$1 = \frac{I_C}{25\,mA}$

$\therefore I_C = 25\,mA$

Voltage amplification, $A_V = \frac{V_o}{V_{in}}$

$= \frac{I_C R_C}{V_{in}}$

$= \frac{25\,mA \times 1kΩ}{500\,mv}$

$= \frac{25 \times 10^{-3} \times 10^{3}}{500 \times 10^{-3}}$

$= 50\,mv$

Date: 05.03.19

From here, After mid-term exam

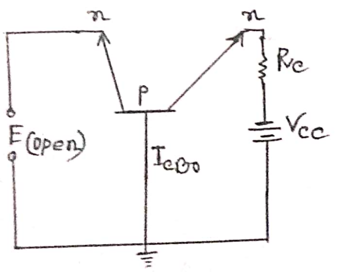
Alaur

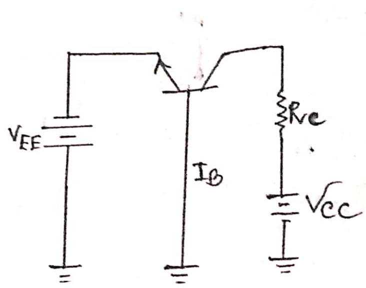
*Expression for collector current: The total collector current consist of —

(i) That part of emiter current which reaches the collector terminal. i.e αI_E.

(ii) The leakage current $I_{leakage}$: This current is due to the movement of minority carriers across base-collector junction on account of it being reverse biased. This is generally much smaller than αI_E.

$\therefore$ Total collector current, $I_C = \alpha I_E + I_{leakage}$.





$\Rightarrow I_E = I_C + I_B$

$\Rightarrow I_C = \alpha I_E + I_{CBO}$

$\Rightarrow I_C = \alpha (I_C + I_B) + I_{CBO}$

$\Rightarrow I_C = \alpha I_C + \alpha I_B + I_{CBO}$

$\Rightarrow I_C (1-\alpha) = \alpha I_B + I_{CBO}$

$\Rightarrow I_C = \dfrac{\alpha I_B + I_{CBO}}{1-\alpha}$

Date: 08-03-19

math: In a commonbase connection, the emiter current is 1mA. If the emiter current is 50μA. Find the total collector current.
Given that, $\alpha = 0.92$

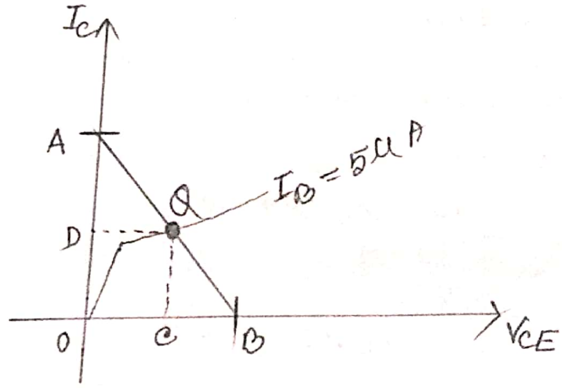
Solution:
$I_E = 1mA$.
When Emiter circuit is open for collector current
$I_{CBO} = 50\mu A$
$\alpha = 0.92$

$\therefore$ Total collector current, $I_C = ?$

$\therefore I_C = \alpha I_E + I_{CBO}$
$= 0.92 \times 1 * 10^{-3} + 50 \times 10^{-6}$
$= 9.7 \times 10^{-4} A$

***Operating point/silent point:** The zero signal values of I_C and V_{CE} are known as operating point. It's called operating point because, the variations of I_C and V_{CE} take place about this point when signal is applied. It's also called quiescent (silent) point or Q-point because it is the point on I_C and V_{CE}.

characteristics when the transistor is silent. i.e: an absence of the signal.



V_{CE} = OC Volts
I_C = OD Volts

*maths: In a transistor circuit, collector load is 4 kΩ whereas quiescent current (zero signal collector current) is 1mA

(i) what is the operating point if $V_{CC} = 10V$? $\boxed{V_{CE} = ?}$

(ii) what will be the operating point if $R_C = 5K\Omega$?

(i) Soln:

when collector load, $R_C = 4K\Omega$

$V_{CC} = 10V$

$I_C = 1mA$

for $R_C = 4K\Omega$ and $V_{CC} = 10V$ then

$$V_{CE} = V_{CC} - I_C R_C$$
$$= 10 - 1\times10^{-3} \times 4\times10^{3}$$
$$= 10 - 4$$
$$= 6V$$

∴ operating point $(V_{CE}, I_C) = (6V, 1mA)$ Ans

(ii) when, $R_C = 5K\Omega$

$I_C = 1mA$

$V_{CC} = 10V$

$$\therefore V_{CE} = V_{CC} - I_C R_C$$
$$= 10 - 5$$
$$= 5V$$ Ans

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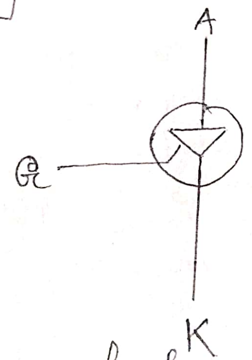
Date: 12-03-19

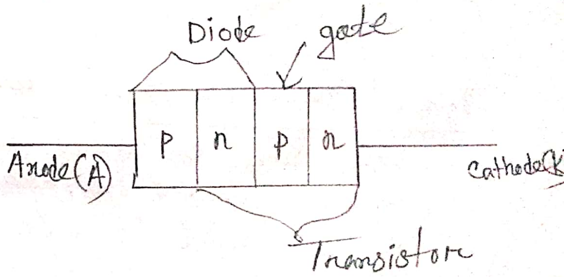
* SCR (silicon Controlled Rectifier): The silicon control rectifier is a ~~three~~ three terminal Semiconductor switching device. which is probably the most important circuit element after the diode and the transistor. The SCR has assumed paramount importance in electronics because it can be produced in Versions to handle current upto several thousand ampears and voltage upto more than.

* Circuit diagram:



Symbol of (SCR)

Construction of SCR:



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* Working of SCR:

(i) when gate is open:

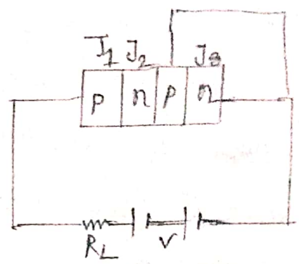
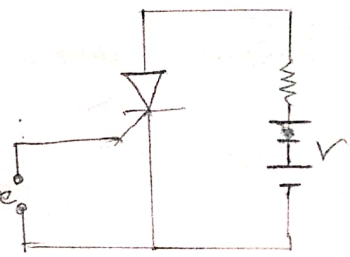


Fig-1(a)

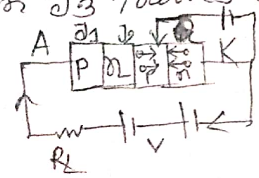
Fig-1: shows the SCR circuit with gate open i.e no voltage applied the gate. Under this condition, junction J_2 is reverse baised while junction J_1 and J_3 are forward baised. Hence the situation in the junction J_1 an J_3 is just as in a open npn Transistor with base open. Consequently no current flows the load, R_L and the SCR is cut off.

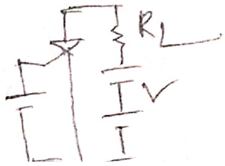


(ii) when gate is positive w.r.t to cathode:

The SCR can be made to conduct heaving at smaller applied voltage by applying a small positive potential to gate as shown in fig-1. Now, junction J_3 is forward baised and junction J_2 is reversed baised. The electron n type material starts moving across junction J_3 towords left whereas hole from p type towords right.

Fig-1(b).





* peak reverse voltage (PRV): peak reverse voltage is the maximum reverse voltage (cathode positive w.r.t to ~~and~~ anode) that can be applied to an SCR with out conducting in the reverse direction.

* circuit fusing rating: it's the products of squre of forword surge current and time of direction of surge

i.e circuit fusing rating = I^2t

maximum value of = $90A^2s$ (circuit fusing rating).

21·03·19

* math: An SCR has a circuit fusing of $50A^2S$. The device is being used in circuit where it could be subjected to a 100A surge. Determine the maximum allow-able duration of such a surge.

Soln:

Fusing rating, $i^2t = 50A^2S$

Value of surge current, $I_S = 100A$

maximum allowable duration, $t_{max} = ?$

We know, From the fusing rating, $I_S^2 t_{max} = i^2t$

$$\Rightarrow t_{max} = \frac{i^2t}{I_S^2}$$

$$\Rightarrow t_{max} = \frac{50A^2S}{(100)^2A}$$

$$= 0.005S$$

Ans.

** Advantage of SCR:

i) It has no moving parts. Consequently, it gives noise less operation at high frequency.

ii) The switching speed is very high upto 10^9 operation per second.

iii) It's permits control over large current (30 – 100A) in the load by means of small gate current (a few of mA).

iv) It has small size and gives trouble free service.

* Voltage gain of JFET Amplifier:

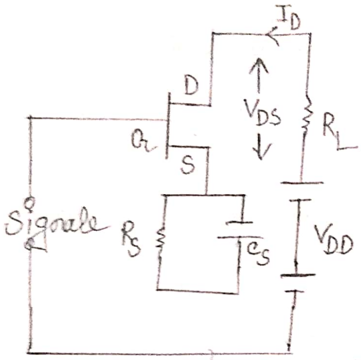


Fig:-1 JFET amplifier.

Fig-1 shows a typical circuit of JFET amplifier. The JFET is self-biased by using network $R_S - C_S$. The DC component of drain current flowing through the source biasing resistance R_S produces the desired bias voltage. The capacitor C_S by passes the a.c component of drain current.

$$R_S = \frac{V_{GS}}{I_D}$$

where,

V_{GS} = Voltage across R_S

I_D = current through R_S

$\therefore$ Voltage gain $\Rightarrow A_V = \frac{\mu R_L}{r_d + R_L}$

$$A_V = \frac{r_d g_{fs} R_L}{r_d + R_L}$$

$\therefore \mu = r_d g_{fs}$

g_{fs} = Transconductance,

if $r_d \gg R_L$ then

$$A_V = \frac{r_d g_{fs} R_L}{r_d}$$

$$A_V = g_{fs} R_L$$

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