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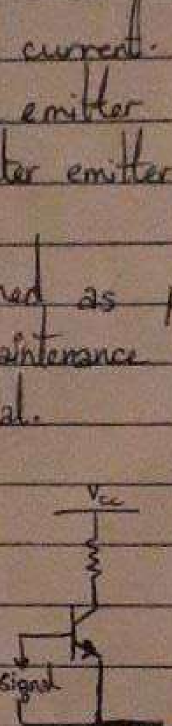
Tutorial - 1

1)- It is the amplification of a signal, particularly a weak one by transistor such that signal changes in amplitude but not in shape. It occurs on transistor with forward bias emitter-base junctions, or reverse biased collector-base junctions, proper zero signal current.

2) A transistor must -
- Have proper zero signal current.
- Have min. proper base emitter voltage (V_{BE}) at any point.
- Have min. proper collector emitter voltage (V_{CE}) too.

Transistor biasing can be defined as proper flow of zero signal collector current and the maintenance of proper collector emitter voltage during passage of signal.

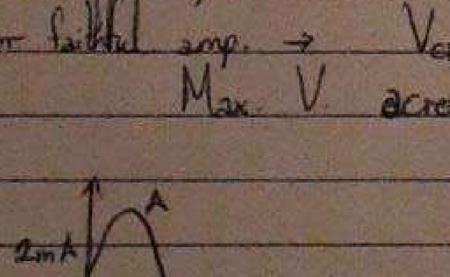
3) npn transistor
$V_{cc} = 6V$, $R_c = 2.5k\Omega$



i)- Max collector,
for faithful amp. $\rightarrow$ $V_{CE} \geq 1V$

Max. V across $R_c \rightarrow$ $V_{cc} - V_{knee} = 6-1 = \underline{\underline{5\Omega}}$

ii)



In +ve peak, Collector current atmost is allowed to be zero.
The +ve and -ve half cycles are equal
So, change in collector current (I_c) will be equal but opposite

$$\text{Min zero signal } I_c = \frac{2mA}{2} = \underline{1mA}$$

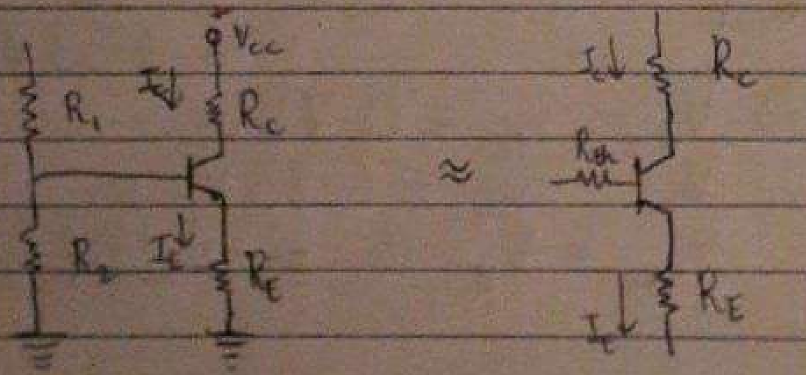
4) Q → i)- Helps know max, min current/voltage upto which device works safely.
ii)- Helps know operating I and V of a device.
iii)- Necessary to bias a transistor.

5) DC Load Line as amplifier →
i) It is the locus of all points at which BJT is in active region
ii)- Used to determine Q point.

It is the load line of DC equivalent circuit defined by reducing reactive components to zero.
It is drawn considering saturation and cutoff regions

6)- When we bias a transistor and don't apply a signal at input load line, it is drawn in DC condition. There is no amplification, as signal is absent.
But when signal is given, the line is called AC load line.

7)-



$$V_{th} = \left(\frac{R_2}{R_1 + R_2}\right) V_{cc} \Rightarrow V_{th} = \frac{R_2}{R_1 + R_2}$$

and $R_{th} = R_1 + R_2$

Circuit $\Rightarrow V_{th} = V_{BE} + I_B R_{th} + (I_B + I_C) R_E$

$$\Rightarrow V_{th} = V_{BE} + I_B R_{th} + (\beta + 1) I_B R_E$$

$$\Rightarrow I_B = \frac{V_{th} - V_{BE}}{R_{th} + (\beta + 1) R_E}$$

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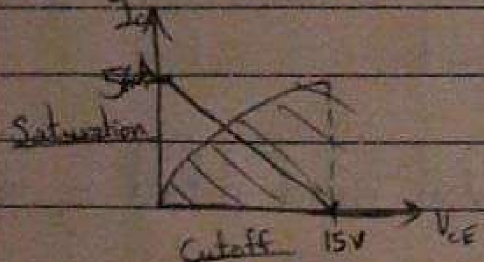
$$[I_{CE}]_{Q\text{-point}} = \frac{\beta (V_{th} - V_{BE})}{R_{th} \ (\beta+1) R_E}$$

$$\Rightarrow [V_{CB}]_{Q\text{-point}} = V_{CE} - I_C R_C - I_E R_E$$

8) $V_{CE} = V_{cc} - I_c R_c$

$\Rightarrow I_c = \dfrac{15 - V_{CE}}{8}$ $\quad\Rightarrow$ When $V_{CE} = 0$, $I_c = 5mA$;

$V_{CE} = 15V$, $I_c = 0$.



9) $$[I]_{B\,Q\text{ point}} = \frac{V_{cc} - V_{BE}}{R_B} = \frac{12 - 0.7}{240} = 47\mu A$$

$$\Rightarrow [I]_{C\,Q\text{ point}} = \beta [I_B]_{Q\text{ point}} = 50 (47.08) = \underline{2.35\mu A}$$

$$[V_{CE}]_{Q\text{ point}} = V_{cc} - I_c R_c = 12 - (2.35\mu A)(2.2k\Omega)$$
$$= 6.33V$$

$$\Rightarrow V_B = V_{BE} = 0.7V$$
$$V_c = V_{CE} = 6.83V$$
$$V_{BC} = V_B - V_c = \underline{-6.13V}$$