A Bipolar transistor has parameters $\beta = 150$, $C\pi = 2pF$, $C\mu = 0.3pF$ and is biased at $I_{CQ} = 0.5mA$ Determine β-cut off frequency.

$V_T = 26mV$

$C_C = 2\pi = 2pF$

$C_C = C\mu = 0.3pF$

$\beta = h_{fe} = 150$

$$f_\beta = \frac{g_m}{2\pi h_{fe}(C_e + C_C)}$$

$$= \frac{19.2 \times 10^{-3}}{2\pi \times 150\,(2 + 0.3) \times 10^{-12}}$$

$$\boxed{f_\beta = 8.87 MHZ}$$

$$g_m = \frac{I_C}{V_T} = \frac{0.5 \times 10^{-3}}{26 \times 10^{-3}}$$

$$g_m = 19.2 MA/V$$

Short circuit CE current gain of transistor is 25 at a frequency of 2MHZ is $f_\beta = 200KHZ$ calculate i] f_T ii] h_{fe} iii] find $|A_i|$ at frequency of 10MHZ and 100MHZ

i] $f_T = |A_i| \times f$

$= 25 \times 2 \times 10^6$

$$\boxed{f_T = 50 MHZ}$$

ii] $h_{fc} = \frac{f_T}{f_B} = \frac{50 MHZ}{200 KHZ} = \boxed{250 KHZ}$

iii] $|A_i| = \frac{h_{fc}}{\sqrt{1+(f/f_B)^2}}$

$|A| = \frac{250 KHZ}{1+(f/200KHZ)^2}$

At $f = 10 MHz$

$|A_i| = \frac{250}{\sqrt{1+\left(\frac{10\times10^6}{200\times10^3}\right)^2}} = 5$

At $f = 100 MHZ$

$|A_i| = \frac{250}{\sqrt{1+\left(\frac{100\times10^6}{200\times10^3}\right)^2}} = \boxed{0.5}$

A high frequency amplifier uses a transistor which is driven from a source with $R_S = 0$. Calculate the value of f_H, if $R_L = 0$ and $R_L = 1K\Omega$. Assume typical value of hybrid -π parameter

i] f_H :

for $R_L = 0$

$$f_H = \frac{1}{2\pi r_{b'e}(C_{b'e} + C_{b'c})} \qquad \left[\because \begin{array}{l} C_{b'e} = C_e \\ C_{b'c} = C_C \end{array}\right]$$

Typical values : $r_{b'e} = 1K$, $C_{b'e} = 100pF$, $C_{b'e} = 3pF$

$$= \frac{1}{2\pi \times 1 \times 10^3 \times [100 \times 10^{-12} + 3 \times 10^{-12}]}$$

$$f_H = 1.545 MHZ$$

For $R_L = 1K\Omega$

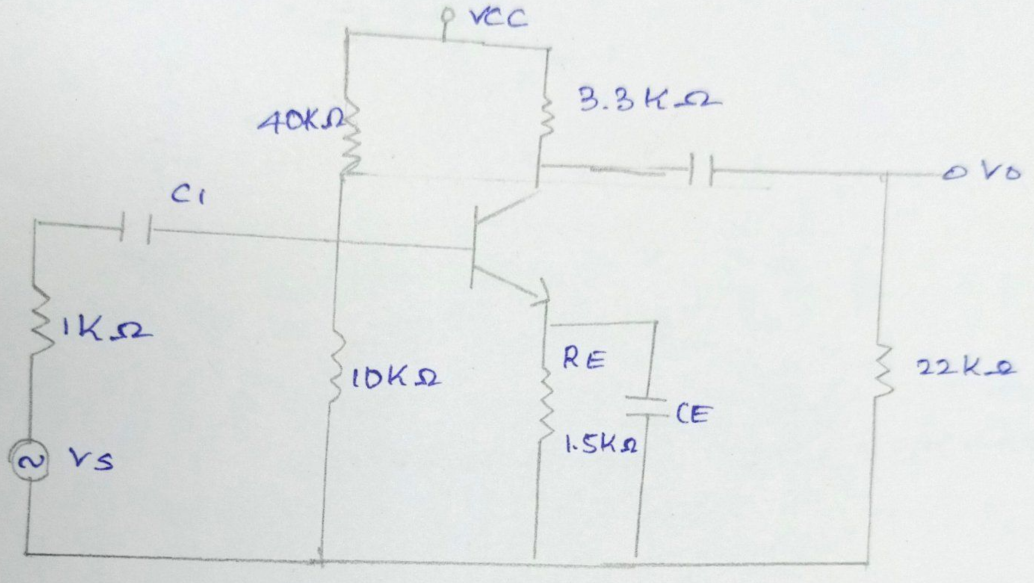
$$f_H = \frac{1}{2\pi r_{b'e}(C_e + C_C(1 + g_m R_L))}$$

$$g_m = 50A/V$$

$$f_H = \frac{1}{2\pi \times 1 \times 10^3 [100 \times 10^{-12} + 3 \times 10^{-12} (1 + 50 \times 10^{-3} + 1 \times 10^3])}$$

$$\boxed{f_H = 0.629 MHZ}$$

For the amplifier shown in fig. Obtain the high frequency response. Assume the values of internal capacitances as follows: $C_{b'c} = 10pf$, $C_{b'e} = 1pf$. The h parameters are $h_{fe} = 100$, $h_{ie} = 1.1K\Omega$, $h_{re} = h_{oe} = 0$



the voltage gain, $A_V = \dfrac{-h_{fe}\,(R_C \| R_L)}{h_{ie}} = \dfrac{-100\,(3.3K\Omega \| 22K)}{1.1K}$

it is a CE amplifier with bypassed R_E

$$A_V = -261$$

$$C_{Mi} = (1 - A_V)\,C_{b'c} = (1+261) \times 10 \times 10^{-12} = 2620pF$$

$$C_{Mo} = \left|\frac{A_V - 1}{A_V}\right| C_{b'c} = \left|\frac{1+261}{261}\right| \times 10 \times 10^{-12} = 10pF$$

i] Input RC Network:

$$f_H\,(\text{inputs}) = \frac{1}{2\pi\; R_S \| R_1 \| R_2 \| h_{ie} \| (C_{b'e} + C_{Mi})}$$

$R_S || R_1 || R_2 || h_{ie}$ - $K || 40K || 1.0K || 1.1K = 490\Omega$

$$f_H \text{ inputs} = \frac{1}{2\pi(490) \times (1+2620) \times 10^{-12}}$$

$$\boxed{f_H (\text{input}) = 123.9 KHZ}$$

ii] Output RC Network

$$f_H \text{ Output} = \frac{1}{2\pi (R_C || R_L) C_{\mu o}} = \frac{1}{2\pi (3.3K || 22K) \times 10P}$$

$$= \frac{1}{2\pi (2.86 \times 10^3) \times 10 \times 10^{-12}}$$

$$\boxed{f_H \text{ Output} = 5.56 MHZ}$$

The input RC network is the dominant network.