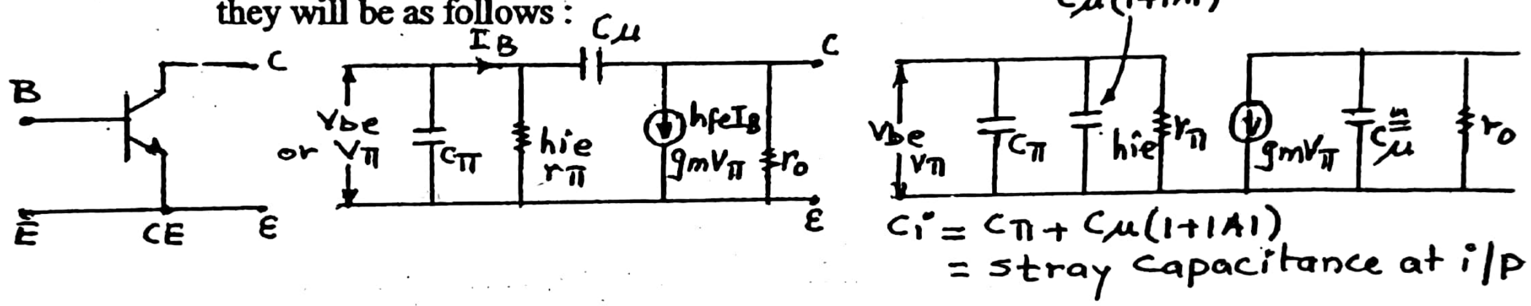
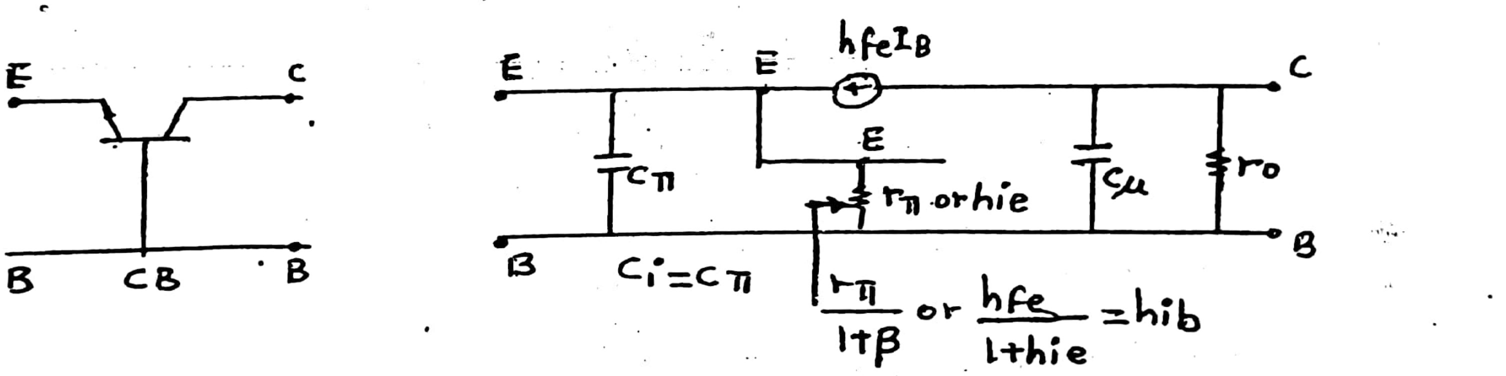
37. Why bandwidth of CB configuration is higher than that of CE configuration **[05]**

Q. Why BW of CB configuration is higher than that of CE configuration? Or why do we use CB amplifier where BW requirement is high?

Ans.: (1) If we draw HF (simplified) ac equivalent circuit of CE and CB configuration they will be as follows :



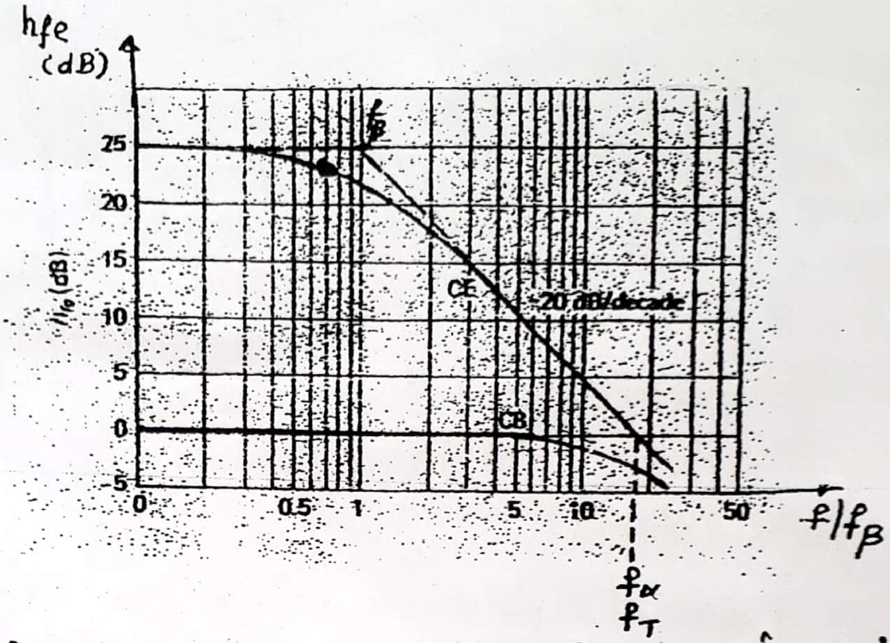


From above diagrams we see that stray capacitance at input in case of CE is large compare to CB. Since f_H (which decides BW $\cong f_H$) is inversely proportion at to Ci, BW of CB configuration is larger than CE configuration.

2) As we have defined f_β as BW of transistor in CE configuration, we can also define f_α for CB configuration. Where $f\alpha$ is frequency at which short circuit current gain of CB configuration (h_{fb}) drops by 3dB. This defines BW of Transistor in CB configuration. f_β and $f\alpha$ are related as $\boxed{f_\beta = f_\alpha(1-\alpha)}$ — (B)

Equation (B) indicates that $f_\alpha > f_\beta$. Hence BW of CB configuration is larger than CE.

RELATION BETWEEN f_β and f_α



The criteria f_β or f_T serve as interrelated figures of merit, useful for the selection of a transistor for a given high-freq. application. The connected circuit components reduces this ideal figure to the operating value of f_H. Figures for f_β or f_T are usually stated in a manufacturer's specification for a transistor type.

Comparision of curves shown above indicates that

$$f_\alpha \cong f_T.$$

$$\therefore \quad f_\alpha = \beta_0 f_\beta \quad \text{but} \quad \beta_0 = \frac{\alpha_0}{1-\alpha_0} \cong \frac{1}{1-\alpha_0} \quad \because \alpha \cong 1$$

$$\therefore \quad f_\alpha = \frac{f_\beta}{(1-\alpha_0)} \qquad \therefore \quad f_\beta = f_\alpha(1-\alpha_0)$$

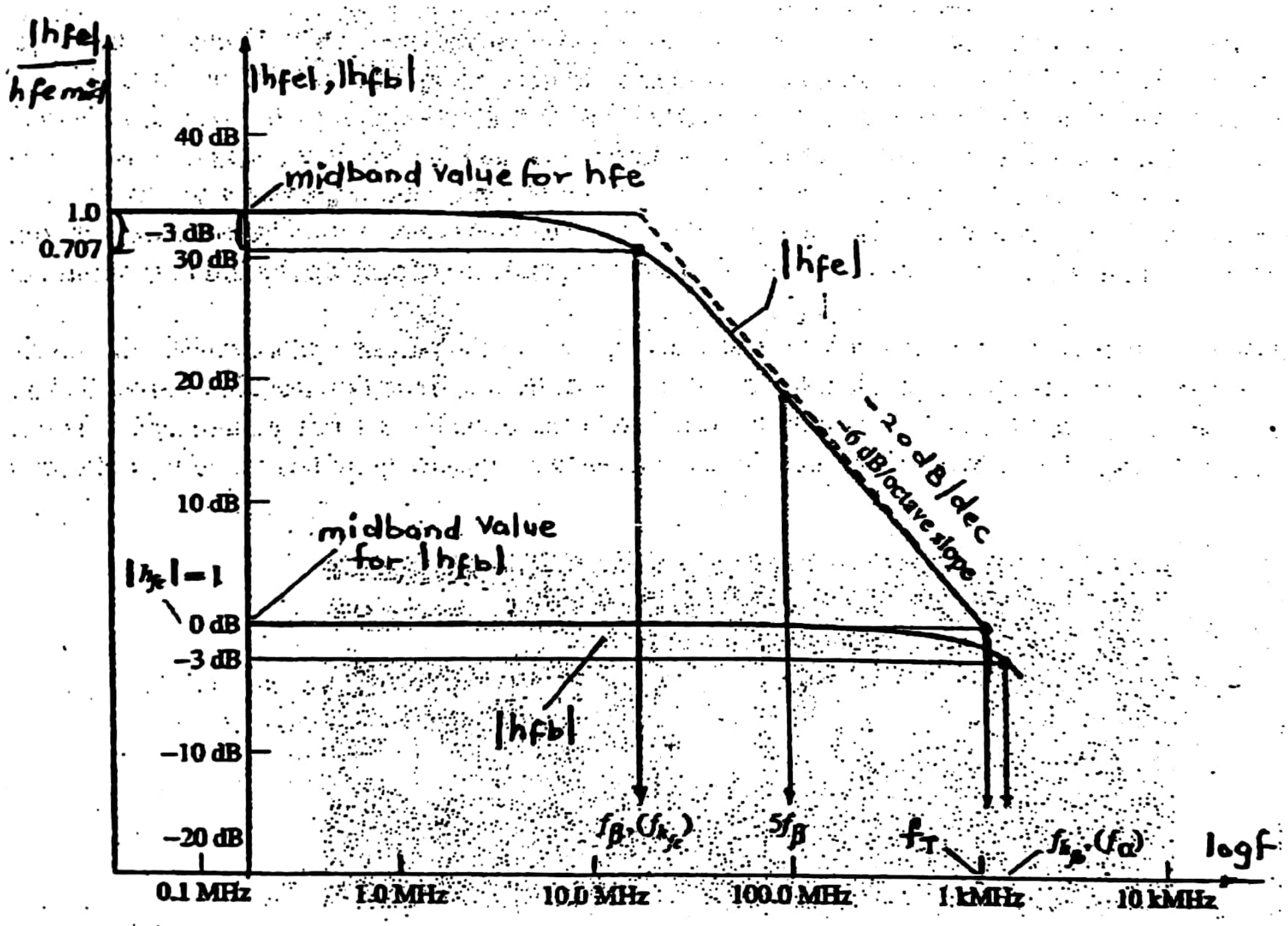
Equation above indicates that f_α is much higher than f_β.

∴ Bandwidth of CB configuration is much higher than CE. Hence CB ampr. are used in application where BW requirement is more. i.e Radio, TV and satellite ...

f_β AS FUNCTION OF BIAS CONFIGURATION

The equation $h_{fe} = \dfrac{h_{femid}}{1 + j(f/f_\beta)}$ is exactly same as $A_v = \dfrac{1}{1 + j\, f/f_H}$

if we remove multiplying factor hfemid, it indicates that hfe will drop off from its midband value with 20dB/dec slope as shown below. The same fig. has plot of hfb (or α) v/s frequency. Note the small change in hfb for the chosen frequency range, it indicates the CB configuration displays improved high frequency characteristics over Common emitter (CE) configuration. This is the reason CB HF parameters rather than CE configuration parameters are often specified for transistors. Specially transistors which are used at HF.



hfe and hfb versus frequency in HF Range.