35. Why gain of RC coupled amplifier falls in high frequency range **[05]**

Q. Why gain of RC coupled amplifier falls in HF range?

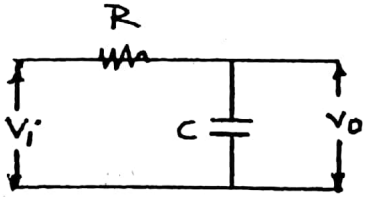
Ans.: (Referring equivalent circuit diagram of amplifier with voltage source)

1) **Input** : At LF and MF, X_{ci} is very high (C_i as good as open)
   In HF range As f increases, Xci decreases, I increases (known as shunting effect)
   I_i decreases, V_i decreases $\therefore$ Av decreases. $\therefore$ C_i is responsible for reduction in gain at HF's.
2) **Output** : At LF and MF, X_{CO} is very high (Co as good as open)
   In HF range as f increases, X_{co} decreases, I' increases (shunting effect), I_o decreases, V_o decreases, $\therefore$ A_v decreases.
   $\therefore$ Co is responsible for reduction in gain at HF's.
3) **Effect of β :** In BJT as frequency increases the h_{fe} (β_{ac}) of transistor reduces i.e.

$$h_{fe(at\,HF)} = \frac{h_{fe}(at\,mid)}{1+j(f/f_\beta)}$$

* **Formula for HCF (f_H)**

$$\frac{V_o}{V_i} = \frac{-jX_c}{-jX_c+R} = \frac{1}{1-\frac{R}{jX_c}}$$



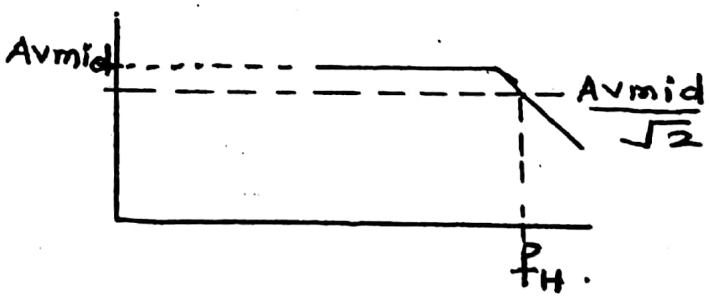
Equnt. ckt. diagram of ampr. (RC coupled) at HF.

$$A_v = \frac{1}{1+j(2\pi RC)f} \quad \boxed{\text{Let } f_H = \frac{1}{2\pi RC}} \therefore \boxed{A_v = \frac{1}{1+j(f/f_H)}} \quad \text{— (1)}$$

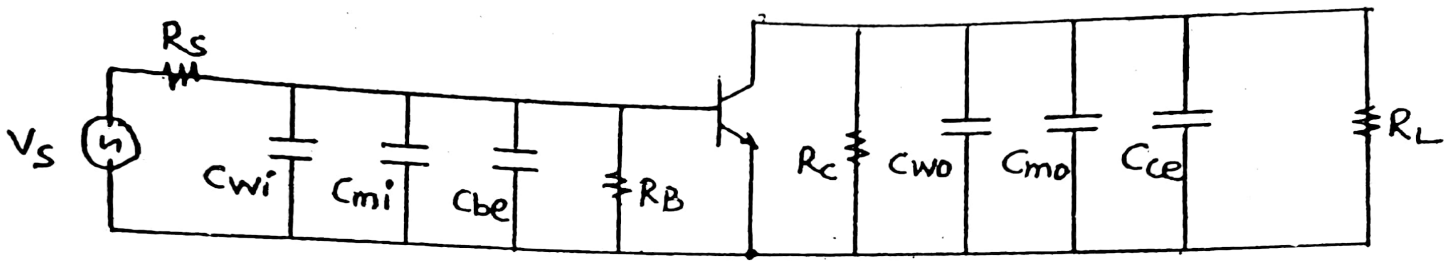
From (1) $|A_v| = \frac{1}{\sqrt{1+(f/f_H)^2}}$ — (2) and $\phi = -\tan^{-1}(f/f_H)$ — (3) output lags input by angle ϕ.

* From (2) at $f = f_H$, $|A_v| = \frac{1}{\sqrt{2}}$ or $|A_v| = \frac{A_{vmid}}{\sqrt{2}}$

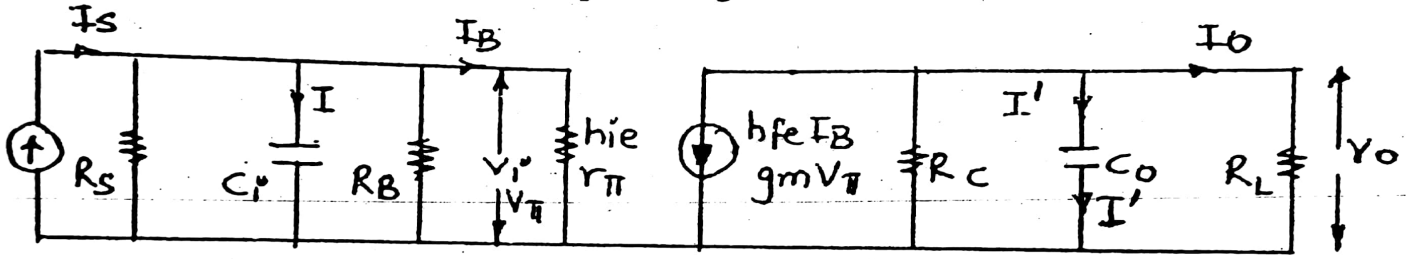
$\therefore$ f_H can be defined as frequency at which gain of amplifier falls to 0.707 times its gain at mid. frequency.



* The –ve sign in (3) indicates that in RC coupled amplifiers output signal lags input by angle ϕ. Hence RC network shown in also known as lagging network or RC coupled amplifier works as lagging network in HF range.



(2) Replacing transistor with model, and input voltage source with current source.



$C_i = C_{wi} + C_{mi} + C_{be}$

$C_o = C_{wo} + C_{mo} + C_{ce}$