UNIT: 2 AMPLIFIERS AT HIGH FREQUENCES

Low frequency analysis:

a) All external capacitances (C_e, C_b, C_c) show their effect in low frequency region hence they cannot be neglected.

b) All internal capacitances behave as open circuit in low frequency regions. Hence they need not be considered.

c) ~~The approximate~~ BJT should be replaced with its approx. h-parameter model during analysis. (For FET low frequency model)

Mid frequency analysis:

a) All external capacitances behave as short circuit.

b) All junction capacitances behave as open circuit.

c) BJT is to be replaced with approx. h-parameter model.

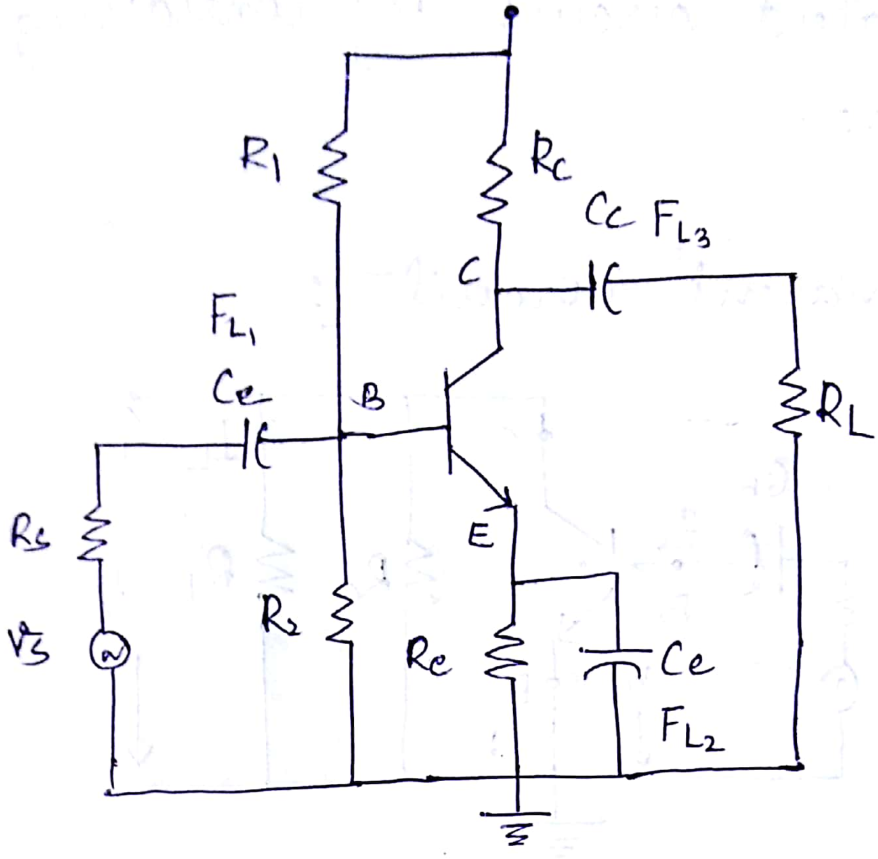
High frequency analysis:

a) All external capacitances behave as short circuit.

b) All junction capacitances show their effect in high frequency region, hence cannot be neglected.

c) BJT should be replaced with hybrid-π model during analysis. (For FET, high frequency model)

Low Frequency Analysis :



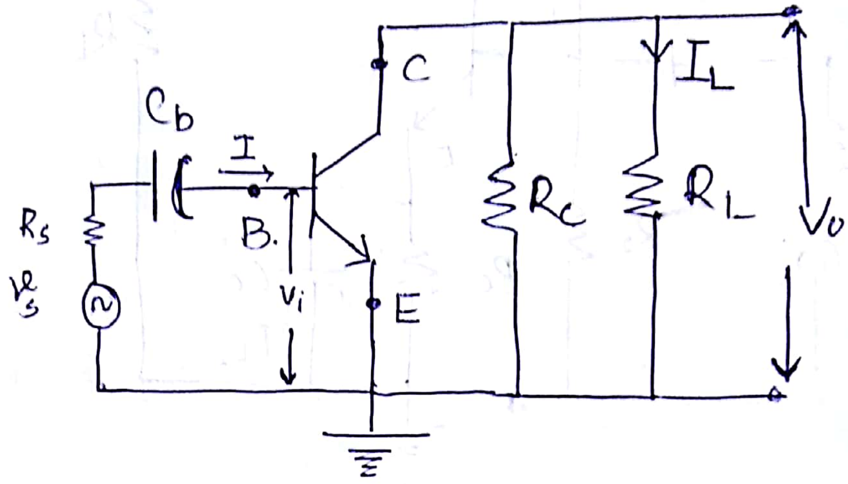
* **Assumptions** :

1. Neglect the biasing resistances R_1 & R_2 (Open R_1 & R_2)
2. Neglect the stabilization resistance as $|R_E| >> \left|\frac{1}{j\omega C_E}\right|$
3. Use approx. h-parameter model for BJT.
4. When C_b is considered, short circuit C_E & C_C.
   " C_e " " " " C_b & C_C
   " C_C " " " " C_e & C_b

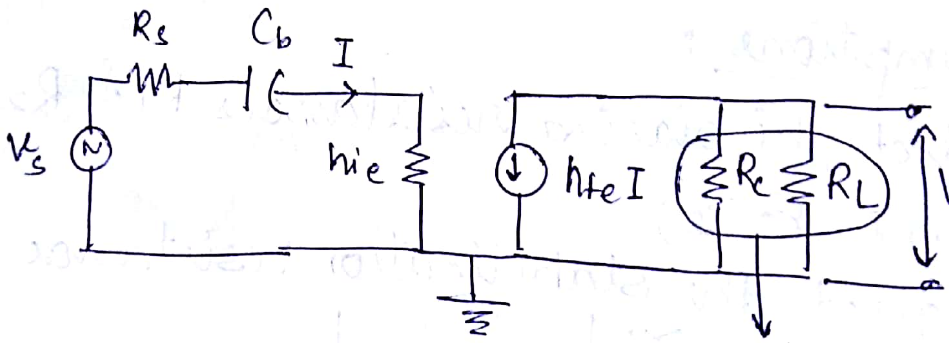
Analysis :

AC equivalent circuit by considering C_b alone.

AC equivalent circuit :



h-parameter model :



$R_L' \rightarrow (R_c \parallel R_L)$

1) $A_{vs} = \dfrac{V_o}{V_s} \longrightarrow A_v$

$= -h_{fe} I \cdot R_L'$

$I = \dfrac{V_s}{Z}$

where $Z = R_s + h_{ie} + \dfrac{1}{j\omega C_b}$

$$V_o = \frac{-h_{fe} V_s R_L'}{Z}$$

$$\Rightarrow A_v = -\frac{h_{fe} V_s R_L'}{Z \cdot V_s}$$

$$A_v = \frac{-h_{fe} R_L'}{Z}$$

$$Z = (h_{ie} + R_s) + \frac{1}{j\omega C_b}$$

$$= (R_s + h_{ie})\left[1 + \frac{1}{j 2\pi f C_b (R_s + h_{ie})}\right]$$

$$= (R_s + h_{ie})\left[1 - \frac{j f_{L_1}}{f}\right]$$

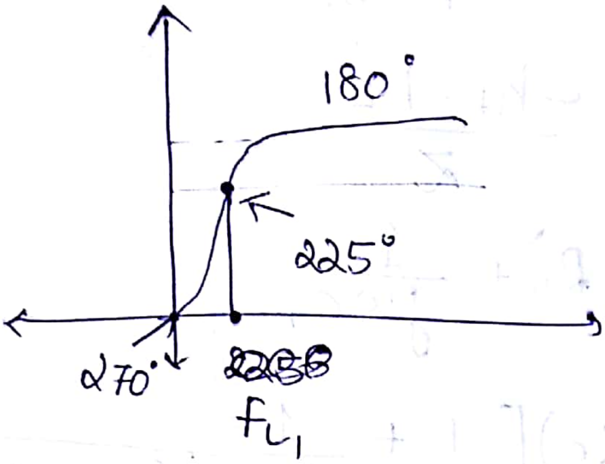
where, $f_{L_1} = \frac{1}{2\pi (R_s + h_{ie}) C_b}$

$$\Rightarrow A_v = \frac{-h_{fe} R_L'}{(R_s + h_{ie})\left(1 - j\frac{f_{L_1}}{f}\right)}$$

$$\therefore A_v = \frac{A_{max}}{\left(1 - j\frac{f_{L_1}}{f}\right)}$$

where $A_{max} = \frac{-h_{fe} R_L'}{R_s + h_{ie}}$

$$A_v = \frac{A_{mid}}{\sqrt{1+\left(\frac{f_{L1}}{f}\right)^2}} \angle 180 + \tan^{-1}\frac{f_L}{f}$$



Phase shift between input & output is decreasing with increase in frequency and became constant at mid-frequency.

different frequencies show different phase shifts (phase distortion).

H.W

1. Perform low frequency analysis by considering C_e alone and derive the expression for its lower 3dB frequency (F_L)
2. Perform the analysis by using C_c alone.