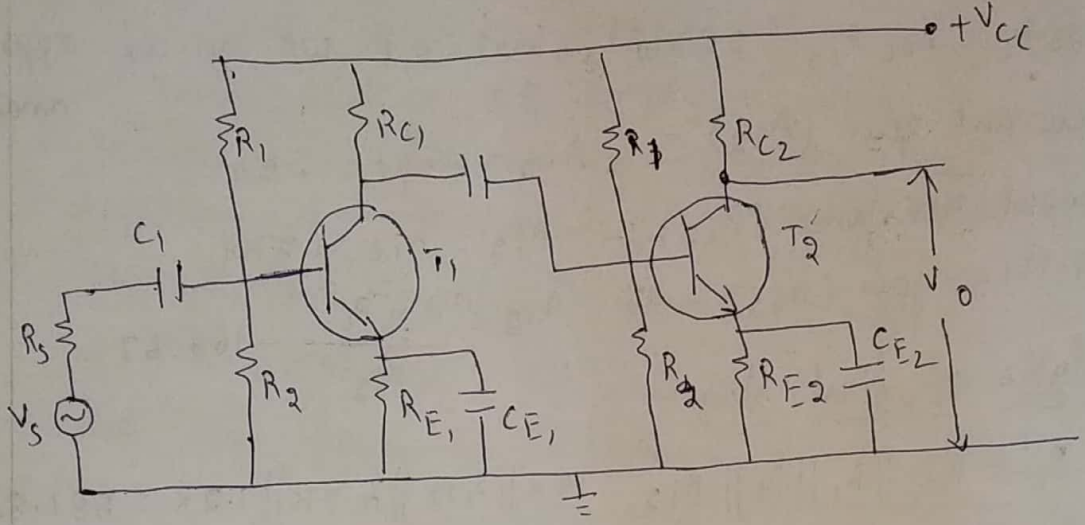
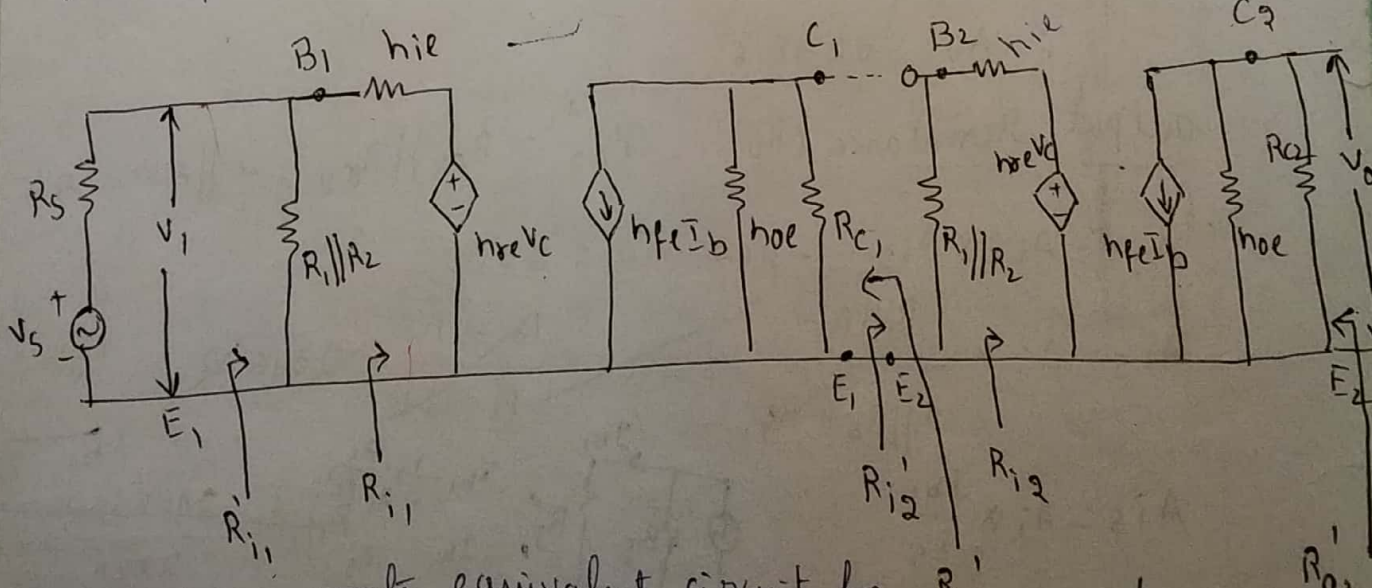
Two stage RC coupled CE-CE Cascade Amplifier:-



CE-CE Cascade amplifier

→ Assuming all capacitors arbitrarily large and act as a short circuit for ac signal we can draw h-para-equivalent circuit for CE-CE cascade amplifier, as shown in fig. Calculate R_i, A_i, A_v, R_o', A_{vs} and A_{is} if circuit parameters are $R_S = 1K$, $R_{C_1} = 15K$, $R_{E_1} = 100\Omega$, $R_{C_2} = 4K$, $R_{E_2} = 330\Omega$ with $R_1 = 200K$ and $R_2 = 20K$ for first stage and $R_1 = 47K$ and $R_2 = 4.7K$ for second stage. Assume that $h_{ie} = 1.2K\Omega$, $h_{fe} = 50$, $h_{re} = 2.5 \times 10^{-4}$ and $h_{oe} = 25 \times 10^{-6}$ A/V.



h-parameter equivalent circuit for CE-CE cascade amp.

Analysis of second stage :-

$h_{oe} R_L = h_{oe} R_{C_2} = 25 \times 10^{-6} \times 4 \times 10^3 = 0.1$ we can use approx analysis

(i) current gain (A_{i_2}) :- $A_{i_2} = -h_{fe} = -50$

(ii) Input resistance (R_{i_2}) :- $R_{i_2} = h_{ie} = 1.2 K\Omega$

(iii) voltage gain (A_{V_2}) :- $A_{V_2} = \frac{A_{i_2} R_L}{R_{i_2}} = -166.67$

Analysis of first stage :-

$R_L' = R_{C_1} \| R_1 \| R_2 \| R_{i_2} = 15K \| 47K \| 4.7K \| 1.2K = 881.8\Omega$

$\therefore h_{oe} R_L' = 0.022 < 0.1$ so we can use approximate Analysis

(i) Current gain (A_{i_1}) :- $A_{i_1} = -h_{fe} = -50$

(ii) Input resistance (R_{i_1}) :- $R_{i_1} = h_{ie} = 1.2 K\Omega$

(iii) voltage gain (A_{V_1}) :- $A_{V_1} = \frac{A_{i_1} R_L'}{R_{i_1}} = -36.74$

overall Gain (A_V) $A_V = A_{V_1} \times A_{V_2} = 6123.45$

overall voltage Gain (A_{VS}) :- $A_{VS} = \frac{A_V \times R_{i_1}'}{R_{i_1}' + R_S}$

$R_{i_1}' = R_1 \| R_2 \| R_{i_1} = 1.13 K\Omega$

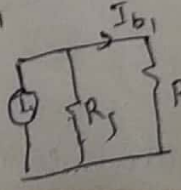
$\therefore A_{VS} = 3248.6$

output Resistance (R_O) :- $R_{O_2}' = R_{O_2} \| R_{C_2} = \infty \| 4K = 4K$

$A_I = A_{i_1} \times A_{i_2} = -50 \times -50 = 2500$

$A_{iS} = A_i \times \frac{R_1 \| R_2}{R_1 \| R_2 + R_{i_1}} = 2500 \times \frac{18.18K}{19.38K} = 2345.2$

$A_{iS} = A_i \times \frac{I_{b_1}}{I_S}$



$I_{b_1} = I_S \cdot \frac{R_S}{R_S + R_{i_1}'}$

$R_1 \| R_2 = \frac{200K \times 220K}{220K} = 18.18K$

$\frac{I_{b_1}}{I_S} = \frac{R_S}{R_S + R_{i_1}'}$ where $R_{i_1}' = R_1 \| R_2 \| R_{i_1}$

Analysis of first stage (CE amplifier):-

(i) Current gain (A_{i1}) :- $A_{i1} = -h_{fe} = -50$

(ii) Input resistance (R_{i1}):- $R_{i1} = h_{ie} = 1.1\,K\Omega$

(iii) Voltage gain (A_{v1}) :- $A_{v1} = \frac{A_{i1} R_{L1}}{R_{i1}} = \frac{-50 \times 21.56}{1.1K} = -0.98$

where $R_{L1} = R_{i2} = 21.56\Omega$.

overall voltage gain (A_v) $= A_{v1} \times A_{v2} = -0.98 \times 136.36 = -133.63$

overall i/p resistance (R_i) $= R_{i1} \| R_B = R_{i1} \| R_3 \| R_4 = 986.1\Omega$

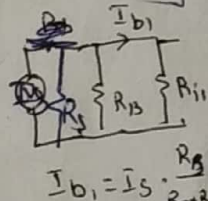
$A_{vs} = \frac{V_o}{V_s} = \frac{V_o}{V_i} \times \frac{V_i}{V_s} = A_v \times \frac{R_i}{R_i + R_s} = -66.35$

$A_I = A_{i1} \times A_{i2}$

$A_{is} = A_i \times \frac{R_B}{R_B + R_{i1}}$

$\therefore R_B = R_3 \| R_4$

$A_{is} = \frac{I_o}{I_s} = \frac{I_o}{I_{c2}} \times \frac{I_{c2}}{I_{e2}} \times \frac{I_{e2}}{I_{c1}} \times \frac{I_{c1}}{I_{b1}} \times \frac{I_{b1}}{I_s}$



$I_{b1} = I_s \cdot \frac{R_B}{R_B + R_{i1}}$

$\frac{I_o}{I_{c2}} = -1$; $\frac{I_{c2}}{I_{e2}} = -A_{i2}$; $\frac{I_{e2}}{I_{c1}} = -1$; $\frac{I_{c1}}{I_{b1}} = -A_{i1}$

$\frac{I_{b1}}{I_s} = \frac{R_B}{R_B + R_{i1}}$ $\therefore A_{is} = -1 \times -A_{i2} \times -1 \times -A_{i1} \times \frac{R_B}{R_B + R_{i1}}$

$= -43.9$

O/P Resistance (R_o) :- $R_o = R_{o2} \| R_L = \infty \| 3K = 3K$.

Direct coupling:-

→ No coupling element

→ It ~~allow~~ affecting the biasing conditions of next stage

→ This unwanted change in the o/p is called drift. It is serious problem in the the Direct coupled amplifiers.

→ DC amplification ~~was~~ done.

→ It is used in amplification of slow varying parameters and where DC amplification is required.

→ It is simple circuit.

Comparison between various Cascading Methods:-

RC coupled :-

→ Coupling elements are Resistors and capacitors.

→ It blocks dc

→ Frequency response is Flat at middle frequencies.

→ Light weight circuit and simple circuit.

→ Used in all audio small signal amplifiers, record players, tape recorders ~~players~~, public address systems, radio receivers and television receivers.

Transformer coupled :-

→ Coupling component is impedance matching transformer.

→ It blocks dc.

→ Frequency response is not uniform, high at resonant frequency and low at other frequencies.

→ It is used in impedance matching

→ It is Bulky and heavy.

→ It is used in amplifiers where impedance matching is an important criteria.

→ It is used in the o/p stage of the public address system to match the impedance of loudspeaker.

→ Used in the RF amplifier stage of the receiver as a tuned voltage amplifier.