05/07/11

To Find the type of Sampling Network

1. By Shorting the output $V_0 = 0$, if feedback signal $x_f \to 0$, then we can say that it is voltage Sampling.
2. By opening the output loop $i_0 = 0$. If feedback signal x_f become zero then we can say that it is current Sampling.

3. To find the type of mixing network

3) If the feedback signal is Subtracted from the Externally applied Signal as a voltage in the input loop, we can say that it is series mixing.

4) If the feedback signal is Subtracted from the Externally applied Signal as a current in the input loop, we can say that it is Shunt mixing.

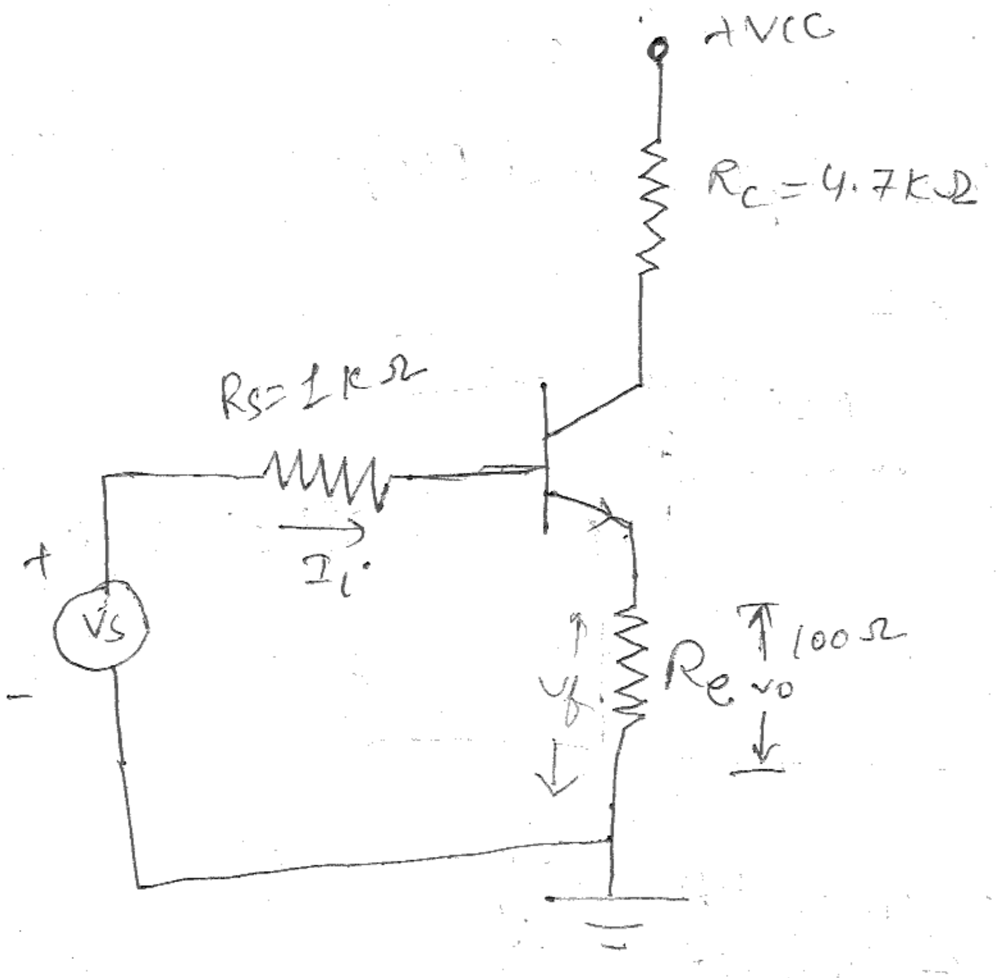
5) Replace each active device by its h parameter model at Low frequency.

6. Find the open loop gain (gain without feedback).
A of the Amplifier

7. Indicate x_f and x_o on the circuit and Evaluate $\beta = \frac{x_f}{x_o}$.

8. From A and β find D (Desensitivity) A_f, R_{if}, R_{of} and R'_{of} (taking R_L into account)

Ex <u>voltage series feedback</u> (for analy



1. Identify topology

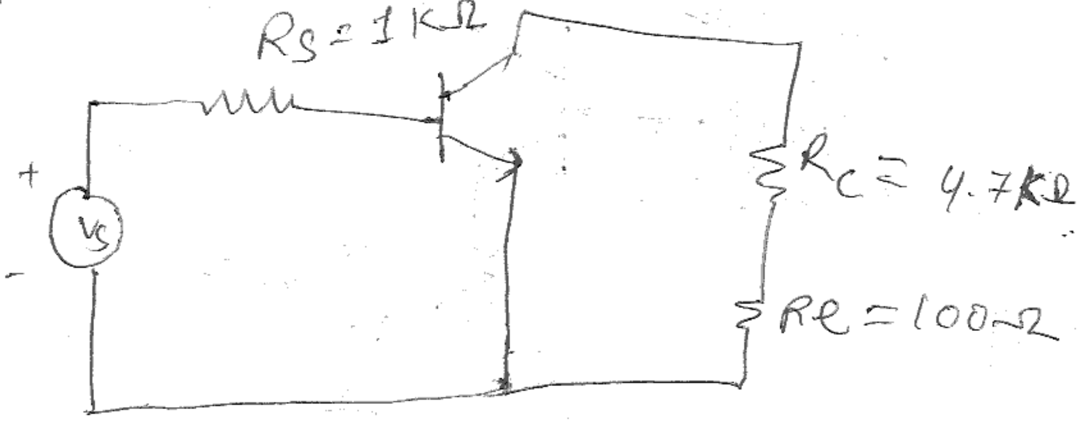
By shorting O/P voltage $V_o = 0$, feedback signal becomes zero and hence it is voltage sampling.

looking at figure (writing KVL) the feedback signal V_f is subtracted from the externally applied signal V_s and hence it is series mixing.

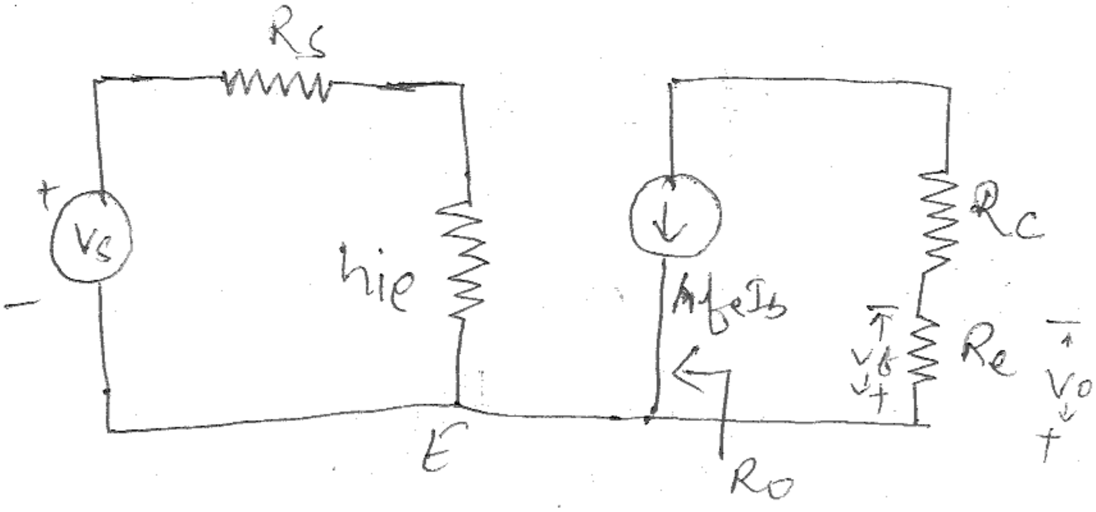
Combining two conditions, we can say that it is voltage series feedback amplifier.

2. Find the input and output circuit

I/P ckt



3. Replace transistor by h parameter equivalent circuit.



<u>Open loop Gain</u> :-

$$A_v = \frac{V_o}{V_s} = \frac{h_{fe} I_b R_e}{V_s}$$

$$V_s = I_b R_s + I_b h_{ie}$$

$$A_v = \frac{h_{fe} \cancel{I_b} R_e}{\cancel{I_b}(R_s + h_{ie})}$$

$$\boxed{A_v = \frac{h_{fe} R_e}{R_s + h_{ie}}}$$

$h_{fe} = 50 \quad R_e = 100$
$R_s = 1K\Omega \quad h_{ie} = 1.1K$

$$A_v = \frac{50 \times 100}{1 + 1.1} = 2.38$$

$$\beta = \frac{V_f}{V_o} = 1$$

$$D = 1 + A\beta$$
$$= 1 + (2.38).1$$
$$= 3.38$$

$$A_{vf} = \frac{A}{1 + A\beta} = \frac{2.38}{3.38} = 0.7$$

$$R_i = R_s + h_{ie} = 1K + 1.1K = 2.1K$$

$$R_{if} = R_i D = (2.1K)(3.38)$$
$$= 7.098K$$

$$R_o = \alpha, \quad R_{of} = \alpha, \quad R'_{of} = \frac{R'_o}{D} \quad R'_o = R_e$$

$$R'_{of} = \frac{R_e}{D} = \frac{100}{3.38}$$
$$= 29.58\,\Omega$$

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UNIT- II

OSCILATORS

Barkhausen criteria :-

The frequency at which a Sinusoidal Oscillator will operate is the frequency for which total shift introduced as a Signal proceeds from the input terminals, through the amplifier and feedback N/W and ~~we~~ again to the input is Precisely zero.
of course an intergral multiple of 2π.

Stated more precisely the frequency of a Sinusoidal oscillator is determined by the condition that the loop gain phase Shift is zero.

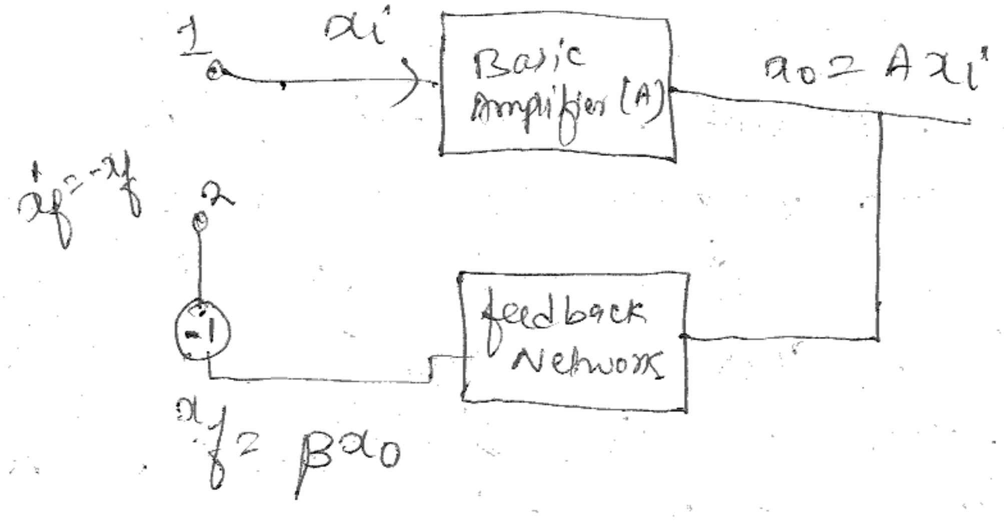
Oscillations will not be Sustained if at the oscillator frequency, the magnitude of the product of the transfer gain of the amplifier and the magnitude of the feedback factor of the feedback N/W (The magnitude of the loop gain) are less than unity.

The condition of unity loop gain $-A\beta = 1$ is called a Barkhausen criteria. This condition implies ofcourse more than magnitude of $|A\beta| = 1$ and that the phase of $-A\beta$ is zero.

The above principles are consistent with the feed back formula

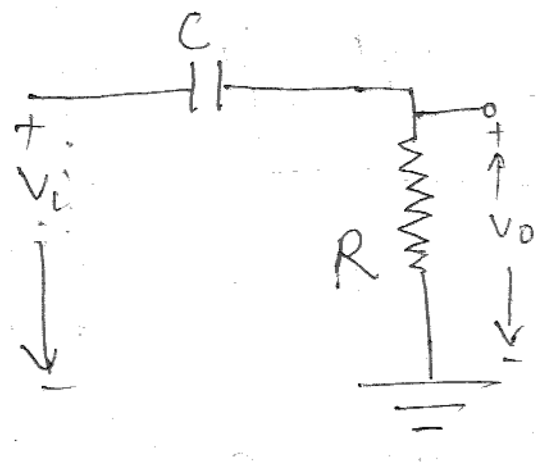
$$A_f = \frac{A}{1+A\beta} \quad \text{for if } -A\beta = 1$$

then $A_f \to \infty$ which may be interpreted to mean that there exist an output voltage even in the absence of an externally applied signal voltage.



Oscillator

RC PHASE SHIFT OSCILLATOR :-



$Z = R - \frac{j}{\omega C}$

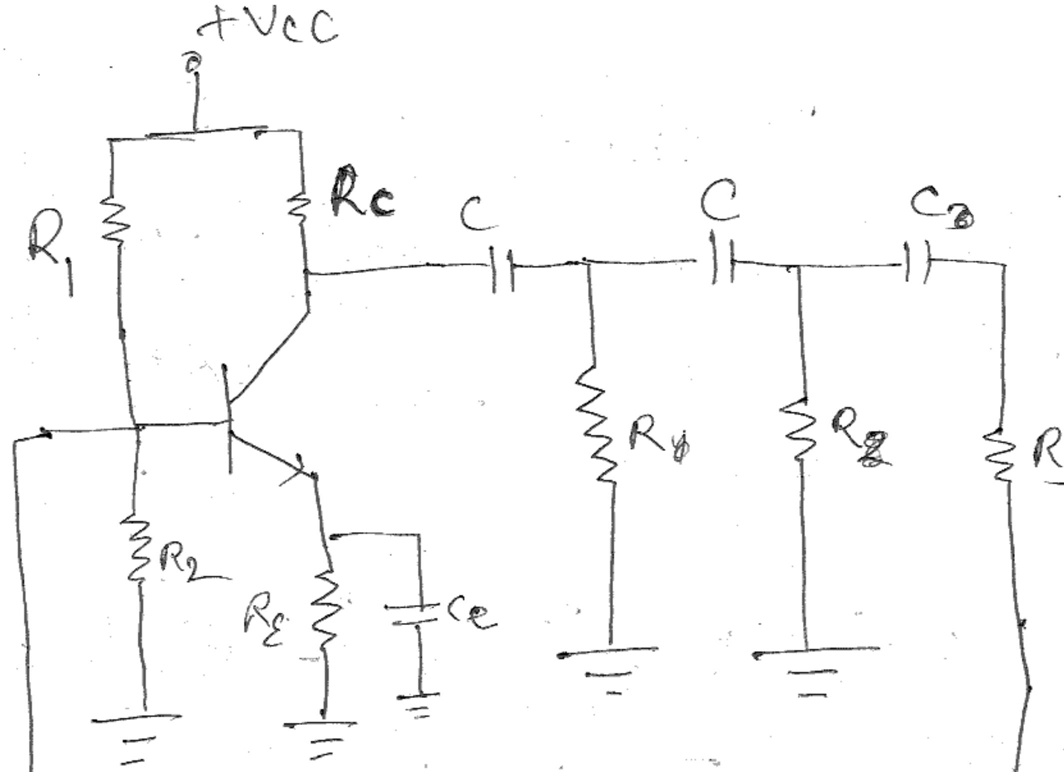
$X_C = Z \angle -\varphi$

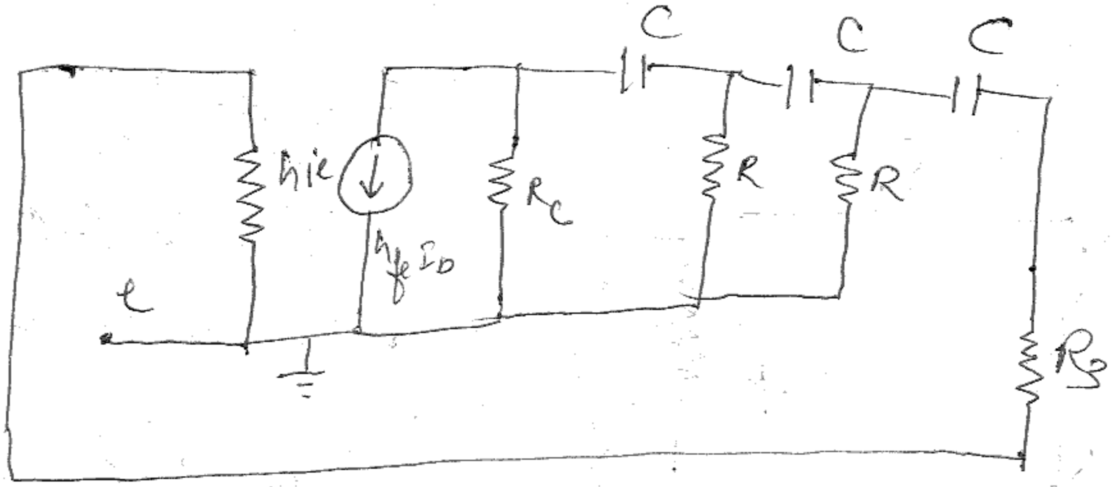
$v_i = V_{in} \sin \omega t$

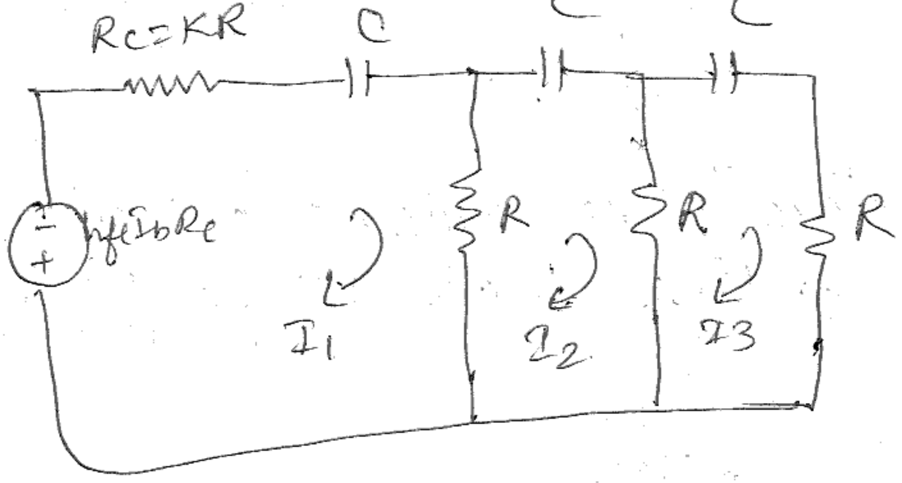
$I = \frac{V_m/\sqrt{2}}{|Z| \angle -\varphi}$

$I = |I| \angle +\varphi$

The positive phase angle $+\varphi$ indicates that the current leads applied voltage by angle φ







$$D = \begin{bmatrix} (K+1)R + \frac{1}{sC} & -R & 0 \\ -R & 2R+\frac{1}{sC} & -R \\ 0 & -R & 2R+\frac{1}{sC} \end{bmatrix}$$

$$\Delta = (K+1)R + \frac{1}{sC}\left[\left(2R+\frac{1}{sC}\right)^2 - R^2\right] +$$

$$R\left[-R\left(2R+\frac{1}{sC}\right) + 0\right]$$

$$\Delta = \left[(K+1)R + \frac{1}{SC}\right]\left[4R^2 + \frac{1}{S^2C^2} + \frac{4R}{SC} - R^2\right]$$

$$+ \left[-2R^3 - \frac{R^2}{SC}\right]$$

$$= \left\{\frac{(K+1)RSC + 1}{SC}\right\}\left\{\frac{4R^2S^2C^2 + 1 + 4RSC - R^2S^2C^2}{S^2C^2}\right\}$$

$$- \left[\frac{2R^3SC + R^2}{SC}\right]$$

$$= \left\{\frac{KSRC + RSC + 1}{SC}\right\}\left\{\frac{3R^2S^2C^2 + 4RSC + 1}{S^2C^2}\right\} - \left\{\frac{2R^3SC + R^2}{SC}\right\}$$

$$= \frac{\left[3KS^3R^3C^3 + 4KS^2R^2C^2 + KSRC + 3R^3S^3C^3 + 4R^2S^2C^2 + RSC + 3R^2S^2C^2 + 4RSC + 1\right]}{S^3C^3} - \frac{2R^3SC + R^2}{SC}$$

$$= \frac{3R^3S^3C^3(K+1) + S^2R^2C^2(4K+7) + SRC(K+4) + 1 - (2R^3S^3C^3 + R^2S^2C^2)}{S^3C^3}$$

$$= \frac{3R^3S^3C^3(K+1) - 2R^3S^3C^3 + S^2R^2C^2(4K+7) - R^2S^2C^2 + SRC(K+5) + 1}{S^3C^3}$$

$$= \frac{1 + R^3 S^3 C^3 (3K+1) + S^2 R^2 C^2 (4K+6) + SRC(K+5)}{S^3 C^3}$$

$$\Delta I_3 = \begin{bmatrix} (K+1)R + \frac{1}{SC} & -R & -h_{fe} I_b K R \\ -R & 2R + \frac{1}{SC} & 0 \\ 0 & -R & 0 \end{bmatrix}$$

$$= \left[(K+1)R + \frac{1}{SC}\right]\left[0\right] + R\left[0\right] - h_{fe} I_b K R \left(R^2 - 0\right)$$

$$\Delta I_3 = -h_{fe} I_b K R^3$$

$$I_3 = \frac{\Delta I_3}{\Delta} = \frac{-h_{fe} I_b K R^3 S^3 C^3}{(3K+1) R^3 S^3 C^3 + (4K+6) S^2 R^2 C^2 + (K+5) SRC + 1}$$

I_3 = output current of the feedback circuit

I_b = Input current of the amplifier

I_c = $h_{fe} I_b$ = input current of the feedback circuit.

$$\beta = \frac{\text{output of feedback ckt}}{\text{Input of feedback ckt}}$$

$$= \frac{I_3}{h_{fe} I_b}$$

$$A = \frac{\text{Output of Amplifier circuit}}{\text{Input to amplifier ckt}}$$

$$= \frac{h_{fe} I_b}{I_b} = h_{fe}$$

$$A\beta = \frac{\cancel{h_{fe}} I_3}{\cancel{h_{fe}} I_b} = \frac{I_3}{I_b}$$

$$A\beta = \frac{I_3}{I_b} = \frac{-h_{fe} K R^3 s^3 C^3}{(3K+1) R^3 C^3 s^3 + (4K+6) R^2 s^2 C^2 + (K+5) sRC + 1}$$

R^2C^2

Sub $s = j\omega$, $s^2 = (j\omega)^2 = j^2\omega^2 = -\omega^2$

$s^3 = (j\omega)^3 = j^2 . j\omega^3$

$= -j\omega^3$

$$A\beta = \frac{I_3}{I_b} = \frac{-h_{fe}\cdot KR^3(-j\omega^3)C^3}{(3K+1)R^3C^3(-j\omega^3) + (4K+6)R^2(-\omega^2)C^2 + (K+5)(j\omega)RC + 1}$$

$$= \frac{+h_{fe}\, jKR^3C^3\omega^3}{-j(3K+1)R^3C^3\omega^3 - (4K+6)R^2\omega^2C^2 + j(K+5)\omega RC + 1}$$

$$= \frac{h_{fe}\, jKR^3C^3\omega^3}{[1-(\omega^2C^2R^2)(4K+6)] + j(\omega RCK + j\omega RC - 3K\omega^3C^3R^3 - \omega^3C^3R^3)}$$

$$A\beta = \frac{h_{fe}\, jKR^3C^3\omega^3}{[1-4K\omega^2C^2R^2 - 6\omega^2C^2R^2] + j[\omega RCK + j\omega RC - 3K\omega^3C^3R^3 - \omega^3C^3R^3]}$$

$$A\beta = \frac{h_{fe}\, jKR^3C^3\omega^3}{[1-4K\omega^2C^2R^2 - 6\omega^2C^2R^2] + j\omega[RCK + 5RC - 3K\omega^2C^3R^3 - \omega^2C^3R^3]}$$

Dividing Numerator and denominator by $j\omega^3R^3C^3$

$$A\beta = \frac{Kh_{fe}}{\left\{\frac{1-4K\omega^2C^2R^2 - 6\omega^2C^2R^2}{-j\omega^3R^3C^3}\right\} - \frac{\{(j\omega)(3K\omega^2R^3C^3) + \omega^2R^3C^3 - 5RC - KRC\}}{-j\omega^3R^3C^3}}$$

Replacing $\frac{1}{j} = -j$

$= Khfe$