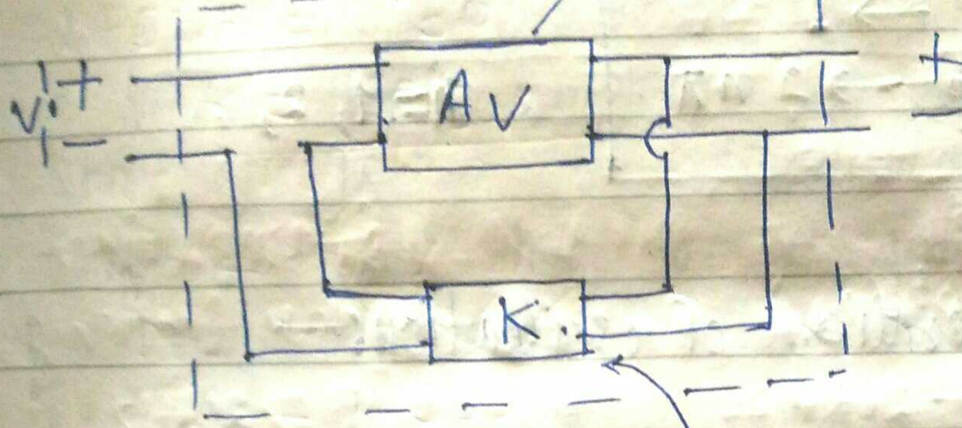
Positive feed back :-

CE amp. (Provides phase shift of 180°)



feedback N/W.
(provides addition phase shift of 180°)

⇓

cannot be resistive N/W.

⇓

always reactive N/W

LC, RC

these ckt called tank ckt.

$$A_f = \frac{V_o'}{V_i'} = \frac{A_V}{1+KA_V}$$ for -ve feed back.

$$A_f = \frac{A_V}{1-KA_V}$$ for +ve "

if $KA_V \to 1$, $A_f \to \infty$

$\Rightarrow \boxed{V_i' = 0}$ → imp. ($\because V_o' \neq 0$)

⇓

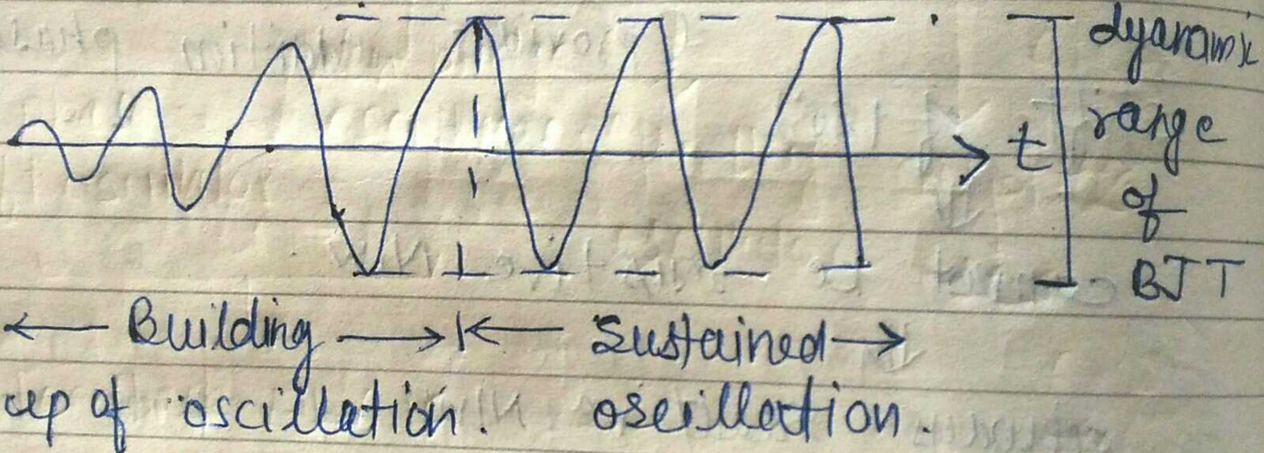
sustained oscillation are obtained at the o/p without any external i/p.

Barkhausen Criterion:—

condition for oscillation.

$$\boxed{\begin{array}{l} |KA_v| \rightarrow 1 \\ \phi \rightarrow 2n\pi \end{array}} \qquad n = 1, 2, \ldots$$

physical generation of oscillation:—



$|KA_v| = 1$ theoritically.

$|KA_v| > 1$ practically.

In general

$$\boxed{|KA_v| \geq 1}$$

condition for oscillation.

* In +ve feedback the o/p voltage is fed back to the I/P which is in-phase with the I/P voltage. Therefor overall f/P voltage is ↑ and

* ripple of Vcc (or ac are reason of oscillation. cripple feedback)

overall voltage gain is increases.

* total phase shift aro and the closed ~~lop~~ loop must be 2π or multiple thereof.
* since the amplifier gives a phase shift of 180° and additional phase shift of 180° has to be provided by the feedback network. There-fore the feed-back is always a reactive n/w.

* The oscillation are produced if the Barkhausen Criterion is satisfied.

* The oscillation will exist in the ckt. if the some ripple components is present in the power supply used in the BJT amplifier.

* since cell does not contain a ripple component, therefore the oscillation are never present if the ~~cell~~ ~~is~~ power supply is replaced by cell.

Oscillators:—

sinusoidal

AF amplifier
(audio amplifier)
f: 20Hz – 20KHz

- RC phase shift oscillator
- Wein bridge oscillator

Feedback N/W is RC type.

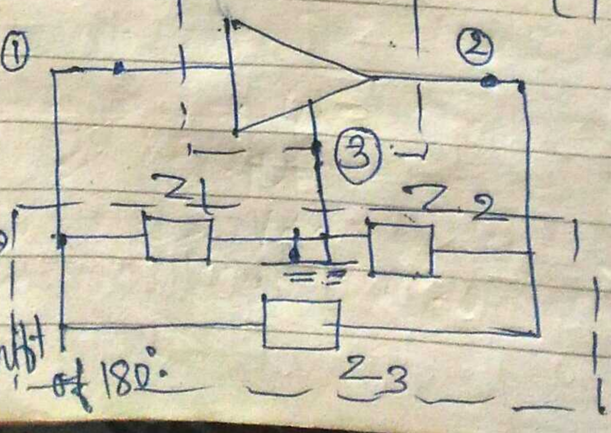
RF amplifier
(radio frequency)
F > 20KHz

- Hartley oscillator
- colpitts osc.
- Clapp
- crystal oscillator

→ feed back used LC N/W or LC tank N/W.

General analysis of RF oscillator:—

→ amplifier (180° phase shift)



feedback N/W (tank N/W) additional phase shift of 180°.

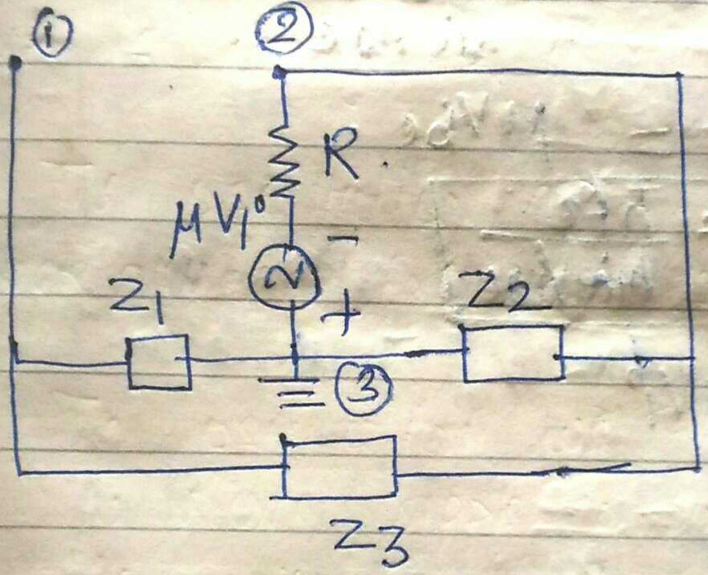
Z_1, Z_2, Z_3 = reactive elements

$Z_1 = jX_1$, =

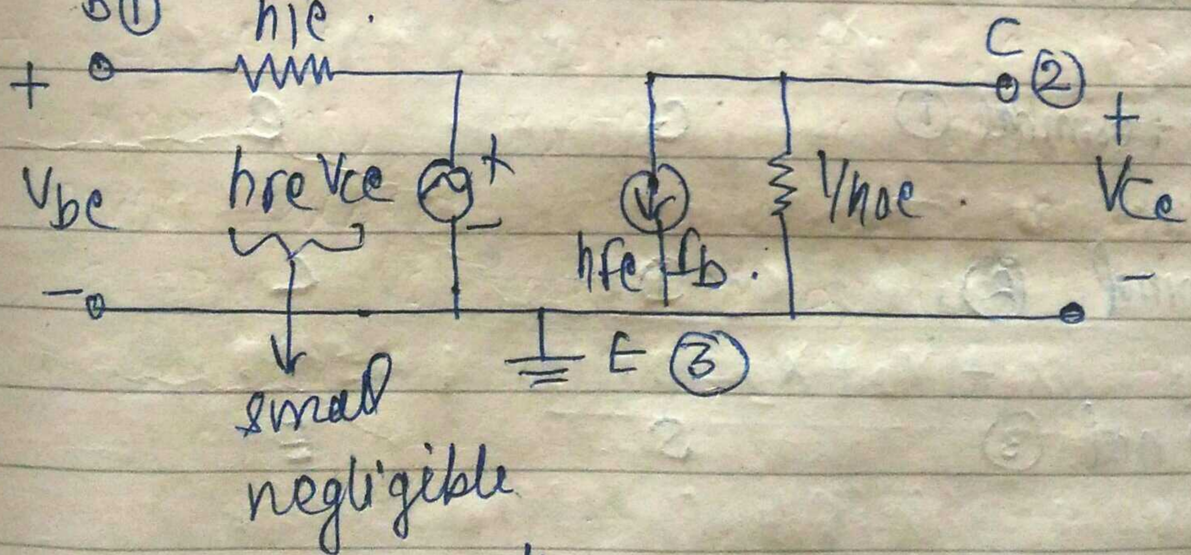
$Z_2 = jX_2$;

$Z_3 = jX_3$;

Equivalent ckt:—



for BJT:— (CE)



⇓

at $\omega = \omega_0$, j term $= 0$

m. Imp $\boxed{X_1 + X_2 + X_3 = 0}$

$$|A_V K| = 1 \Rightarrow \left| \frac{\mu X_1 (\cancel{X_1 + X_3})}{-X_2(\cancel{X_1 + X_3})} \right|$$

$$= \left| \frac{\mu X_1}{-X_2} \right|$$

$$= \left| \frac{\mu X_1}{X_2} \right| = 1$$

$$|\mu| = \frac{X_2}{X_1} = \frac{X_2}{X_1}$$

$$\boxed{|\mu| \geq \frac{X_2}{X_1}}$$

Summary :-

1) $\boxed{X_1 + X_2 + X_3 = 0}$; $\omega = \omega_0$.

gives frequency of oscillations.

2) $\boxed{|\mu| \geq X_2 / X_1}$

condition for oscillation to occur.

Case 1:→ Hartley osc:→

X_1, X_2 } inductor $X_1 = j\omega L_1$

$X_2 = j\omega L_2$

X_3 } capacitor. $X_3 = -1/\omega C_3$

$X_1 + X_2 + X_3 = 0$ at ω_0.

$$\omega_0 L_1 + \omega_0 L_2 + \frac{(-1)}{\omega_0 C_3} = 0$$

$$\omega_0^2 = \frac{1}{(L_1+L_2)C_3}$$

$$\boxed{f_0 = \frac{1}{2\pi\sqrt{(L_1+L_2)C_3}}}$$ frequ. of osc

$|M| \geq X_2/X_1$

condition of osci.

$|M| \geq L_2/L_1$

Case 2:— Colpitts osc:—

$X_1, X_2 =$ capacitor

$X_3 =$ inductor.

$X_1 = -1/\omega C_1$

$X_2 = -1/\omega C_2$

$X_3 = \omega L_3$

$X_1 + X_2 + X_3 = 0$, at $\omega = \omega_0$.

$-1/\omega_0 C_1 - 1/\omega_0 C_2 + \omega_0 L_3 = 0$.

$$\boxed{f_0 = \frac{1}{2\pi}\sqrt{1/L_3(1/C_1 + 1/C_2)}}$$ frequ. of osci.

$|\mu| \geq X_2/X_1$

$$\geq \frac{-1/\omega_0 C_2}{-1/\omega_0 C_1}$$

$$\boxed{|\mu| \geq C_1/C_2}$$ condition of oscillation.

Case 3:— Calpp osc.:—

$X_1 =$ } capacitor.
$X_2 =$

$X_3 =$ series combination of L_3, & C_3.

= adjust the frequ. of osc. by ~~a~~ the C_3. (L_3).

= fine tuning of oscillation. because variation done only in capacitor.

$X_1 + X_2 + X_3 = 0$ at $\omega = \omega_0$

$$-1/\omega_0 C_1 - \frac{1}{\omega_0 C_2} + \omega_0 L_3 - \frac{1}{\omega_0 C_3} = 0$$

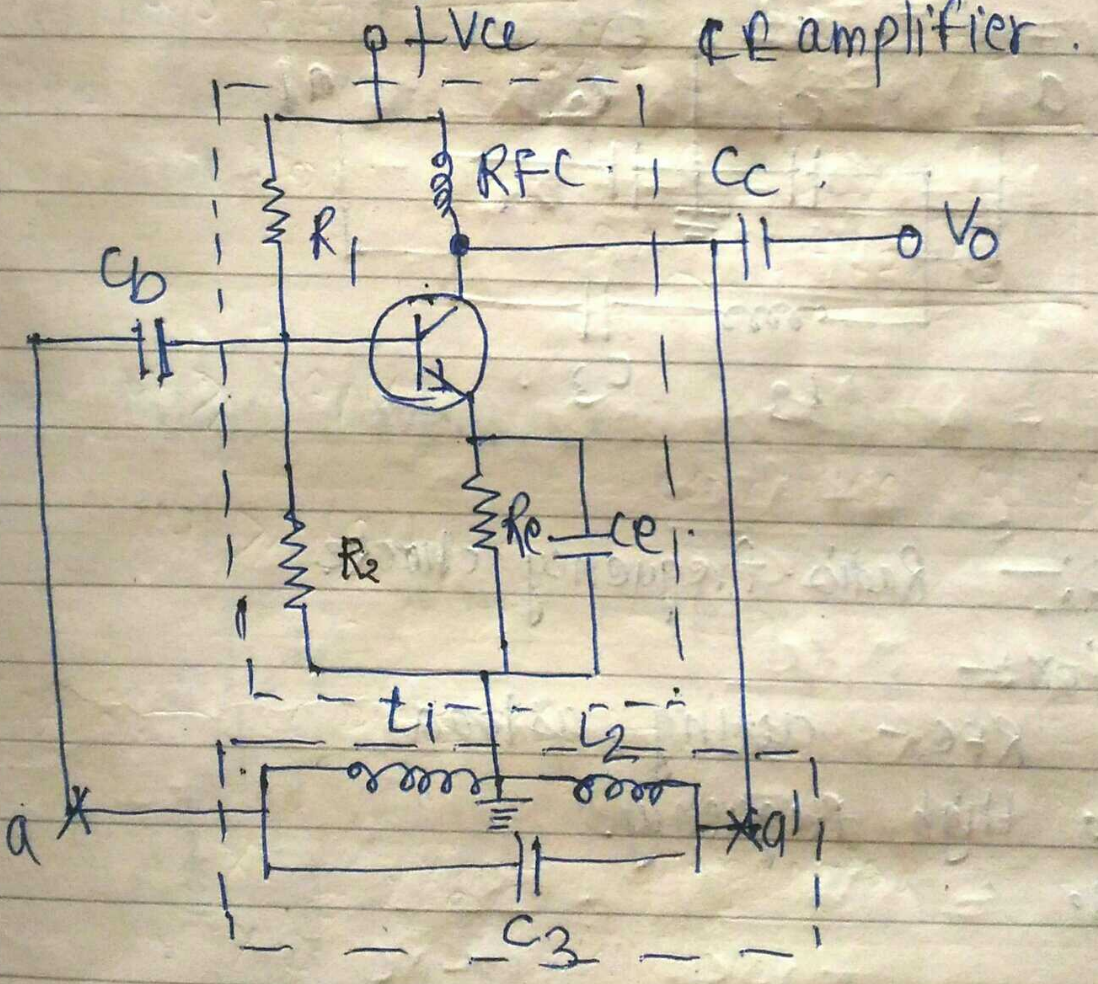
$$\omega_0 L_3 - \frac{1}{\omega_0}\left(1/C_1 + 1/C_2 + 1/C_3\right) = 0$$

$$\boxed{f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{L_3}\left(\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}\right)}}$$

$|M| \geq X_2/X_1$

$\boxed{|M| \geq C_1/C_2}$ condition of osc.

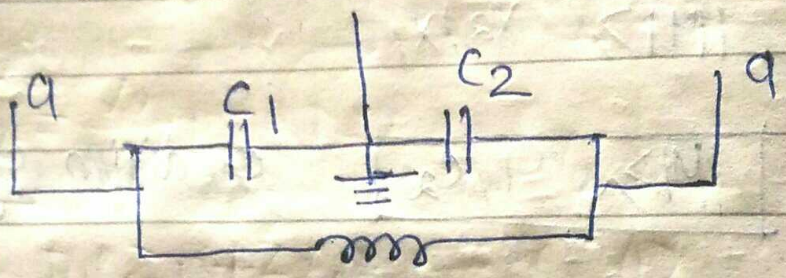
Ckt. of Hartley oscillator :-



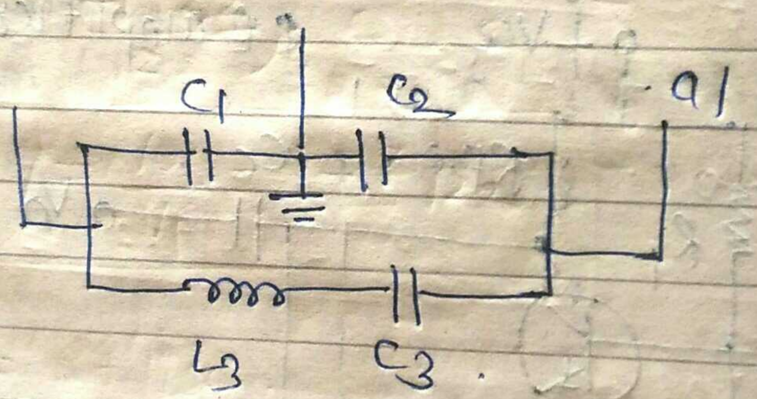
feedback N/W (tank ckt) additional phaseshift of 180°.

for Colpitts:-

feedback N/W:-



for clapp ckt:-



RFC:- Radio frequency chocke

function:-

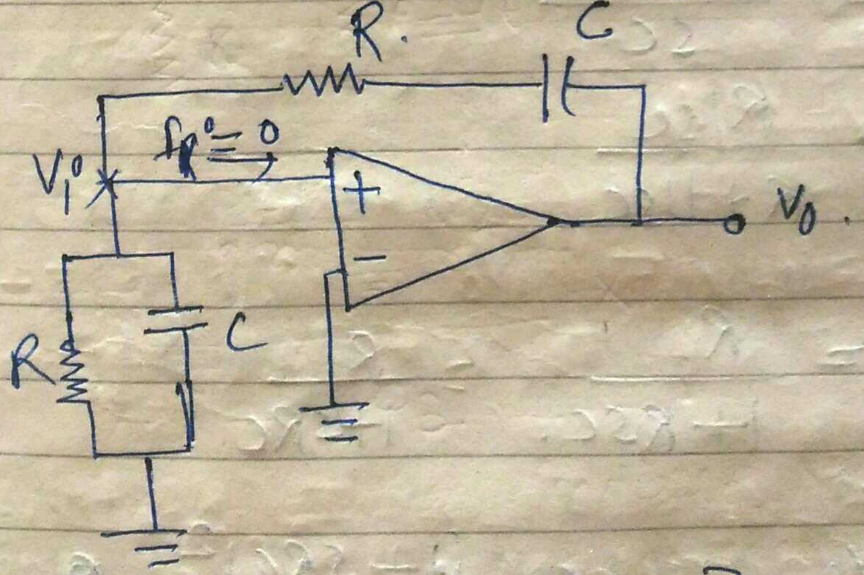
1. RFC - acting as load.
2. High frequency.
3.

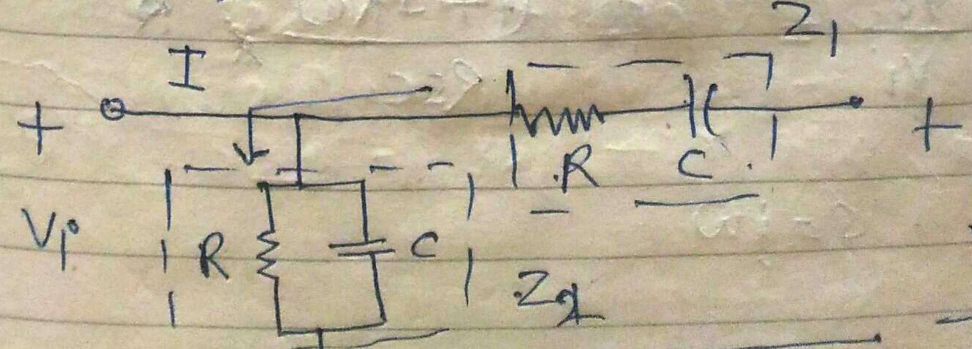
X 1. Acts as Load impedance for the common emitter amplifier, since the resistive portion includes the losses in the

2. Acts as almost o/c for RF oscillation and therefore these oscillation do not disturbed the power supply Vcc ;

3. Acts almost as a S/c for the ripple component of the 50 Hz so that such ripple voltage is available for the production of the oscillation. At the same time the magnitude of initial ripple component is relatively small so that the Q point fixed along the load line is relatively constt.

<u>Wein Bridge Oscillator :—</u>





$|A_v K| = 1$

$A_v = \frac{1}{K}$.

$A_v = \frac{V_0}{V_i}$

KVL:-

$V_0 = I(Z_1 + Z_2)$ ----- ①

$V_i = I Z_2$ ----- ②

$A_v = \left(\frac{Z_1 + Z_2}{Z_2}\right)$

$$\boxed{A_v = \frac{V_0}{V_i} = 1 + Z_1/Z_2}$$

$Z_1 = R + 1/sC$.

$= \frac{1 + RsC}{sC}$

$Z_2 = \frac{R/sC}{R + 1/sC}$

$= \frac{R}{1 + RsC}$. $= \frac{R}{1 + sRC}$

$A_v = \frac{V_0}{V_i} = 1 + \frac{(1 + sRC)^2}{RsC} \cancel{\times} R$

$s = j\omega$

$$= 1 + \frac{(1+j\omega RC)^2}{j\omega RC}$$

$$= 1 + \frac{(1 - \omega^2 R^2 C^2 + 2j\omega RC)}{j\omega RC}$$

$$= 1 + \frac{1}{j\omega RC} - \frac{\omega RC}{j} + 2$$

$$A_V = 3 + j(\omega RC - 1/\omega RC) \quad \text{--- (a)}$$

at $\omega = \omega_0$, frequ. of oscillation :-

$$\omega_0 RC - \frac{1}{\omega_0 RC} = 0$$

$$\omega_0^2 R^2 C^2 = 1$$

$$\omega_0 = 1/RC$$

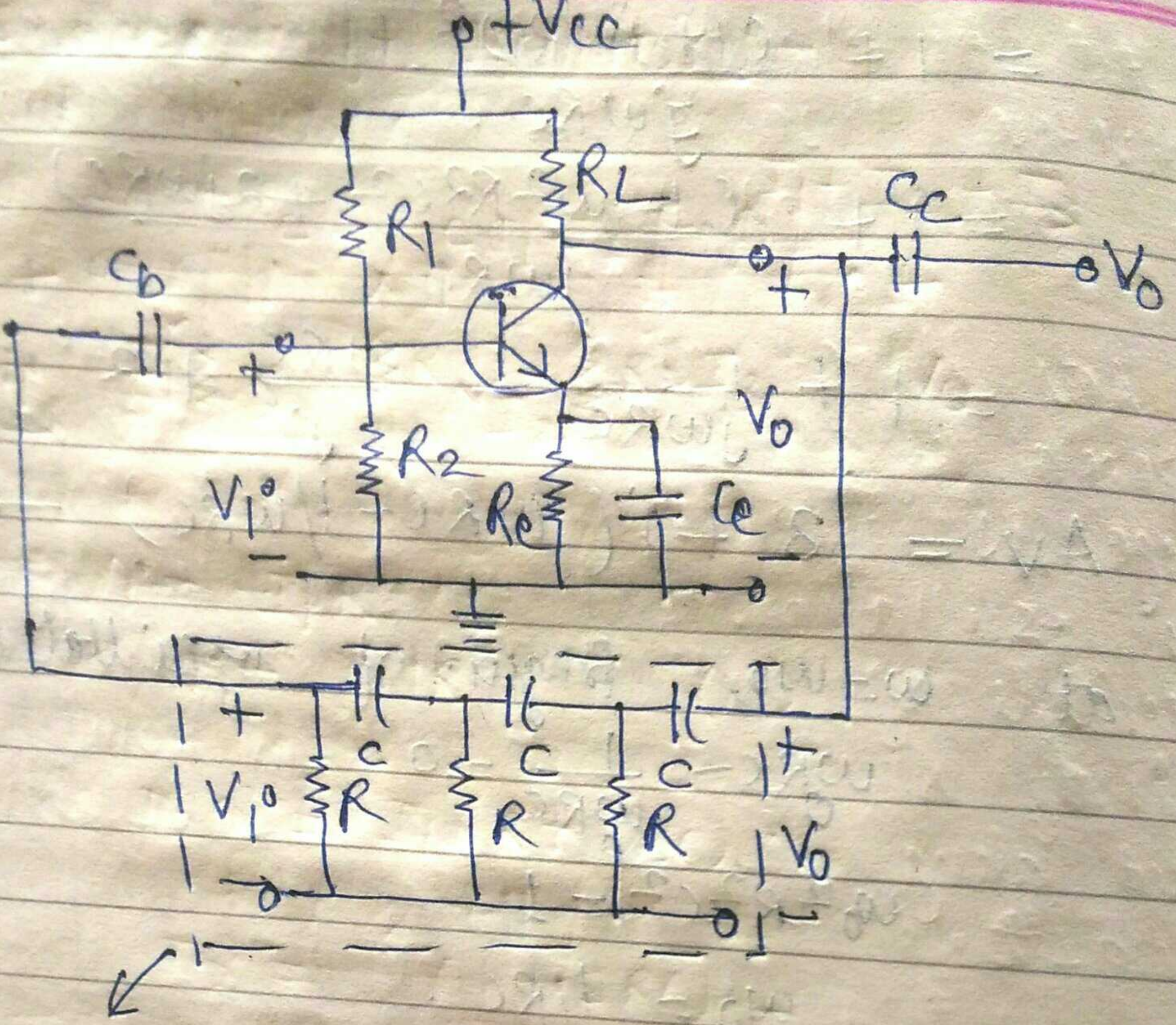
$$\boxed{f_0 = \frac{1}{2\pi RC}}$$ frequ. of osci.

from eqn (a)
at $\omega = \omega_0$.

$$A_V = 3 + j0$$

$$\boxed{A_V \geq 3}$$ condition of oscillation.

RC phase shift oscillator:—



feedback ckt. (Provided an additional phase shift ~~of~~ 180°)

$A_v = V_o / V_i$

$K = 1/A_v = V_i / V_o$ $\quad \therefore |A_v K| = 1$

* why R_L.

* why 3 capacitor. → (60° phase shift each)

at AF:– inductor:– $j\omega L$ = low → large, size large.

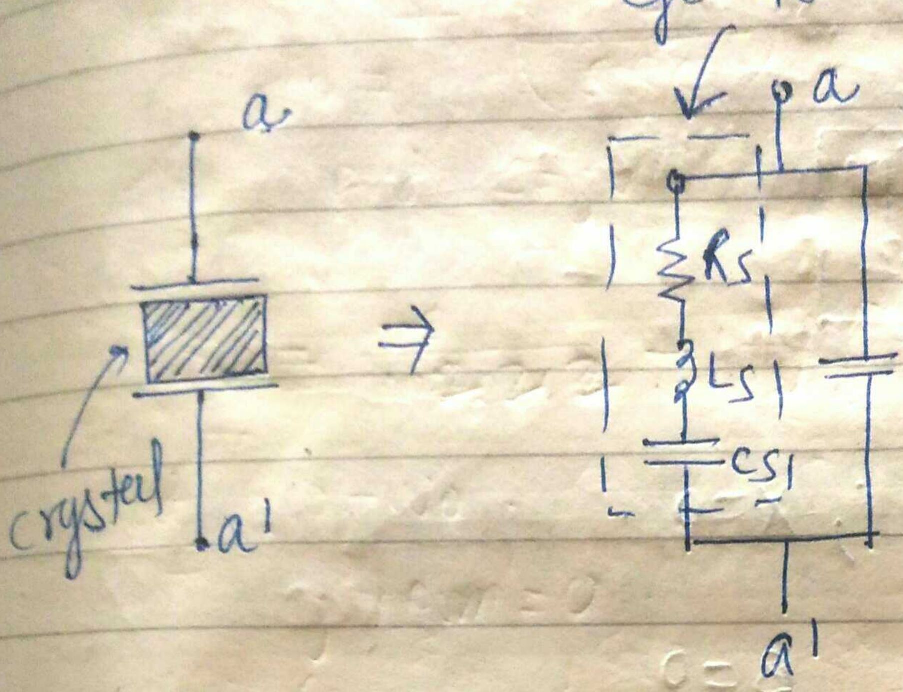
Date:

* at audio frequencies to obtain the required value of impedance the size of the inductor is very large. therefore any inductor is never used at audio frequencies in any ckt.

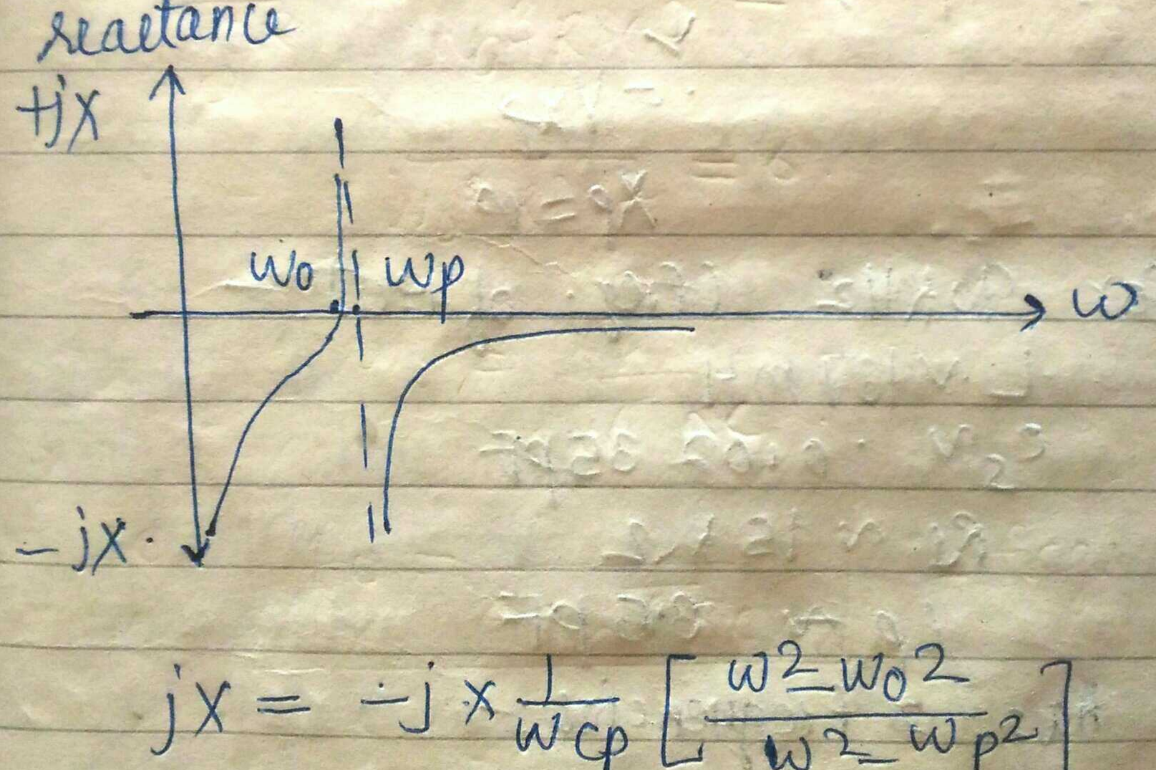
To find:- 1) fo.
2) condition of oscillation.

$$\boxed{\begin{array}{c} f_o = \dfrac{1}{2\pi\sqrt{6}RC} \\ A_V \geq -29 \end{array}}$$

Crystal oscillator :—



Cp = packaging capacitance



$$jX = -j \times \frac{1}{\omega C_p}\left[\frac{\omega^2 - \omega_0^2}{\omega^2 - \omega_p^2}\right]$$

$$\boxed{f_s = \frac{1}{2\pi\sqrt{L_s C_s}}}$$

$$f_p = \frac{1}{2\pi} \sqrt{\frac{1}{L_s}\left(\frac{1}{C_s} + \frac{1}{C_p}\right)}$$

$$\boxed{f_p = 1/2\pi \sqrt{\frac{1}{L_s}(1/C_s + 1/C_p)}}$$

$C_p >> C_s$

$$\boxed{\begin{matrix} f_s \simeq f_p \\ \omega_s = \omega_p \end{matrix}}$$

$Z = R + jX$

$\omega = \omega_s$, $X = 0$.

$Y = G + jB$

$\omega = \omega_p$, $B = 0$

$\Downarrow$

$= 1/X_p$

$X_p = \infty$

for 90 KHz (freq. of osci) :-

$L \sim 137\ mH$

$C_s \sim .0102\ 35 pF$

$R_s \sim 15\ K\Omega$

$C_p \simeq 3.5\ pF$

* it has 2 frequencies :-

1) ω_0 = where $X = 0$

2) ω_p = where $X = \infty$.

Page No.
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Features:—

* The crystal oscillator is used when exceptional frequency stability is required.

* It uses a piezo electric crystal usually of quartz usually of inducting element for the crystal osci. CKT. because its value is high.

* The frequency of the crystal depends upon :—
  1. orientation of the crystal surfaces with respect to its axis.
  2. Its dimensions
  3. Mounting mechanism.

* The frequency of oscillation range from few KHz to few MHz.

* As the frequency of oscillation of a crystal goes up, its size is reduced.

* The crystals are fabricated by taking special cuts along certain crystal axis. These cuts then determine the temp. characteristics as well as the frequency of oscillation.

* A crystal is capable of having a frequency stability of ·001 % over a very large temp range, this is