Oscillator

It is an electronic circuit which generates an as output signal without requiring any externally applied input signal.

i.e circuit gives output without input.

Comparison between Amplifier and oscillator

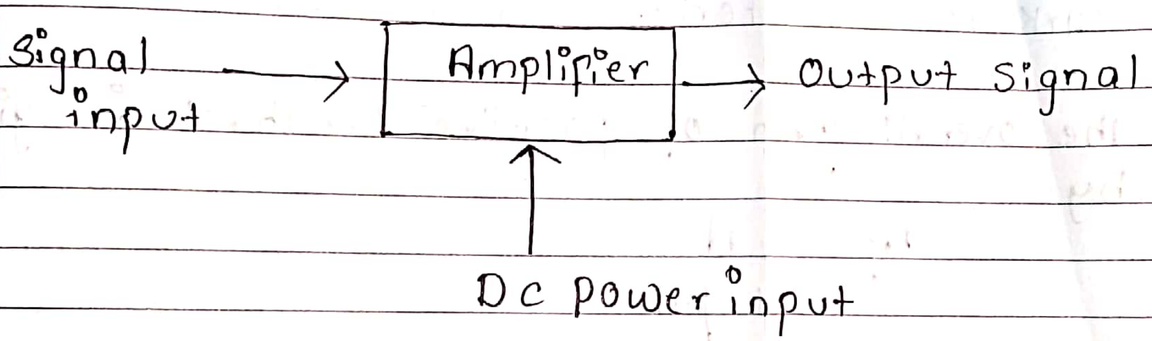

Fig: Amplifier

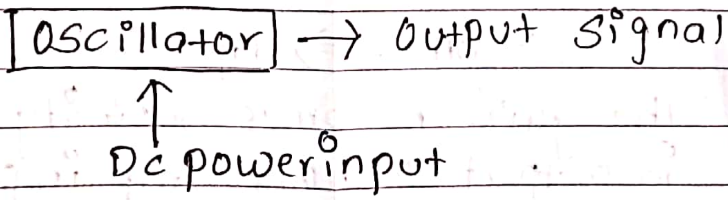

Fig: Oscillator

Oscillator is the case of positive feedback

We know,

$$A' = \frac{A}{1 - \beta A}$$

If $\beta A = 1 \Rightarrow A' = \infty$

i.e $\frac{V_0}{V_{in}} = \infty$

This is possible if $V_{in} = 0$

This means there is output in the absence of input which is the condition for oscillation.

So, necessary condition for oscillator is $\beta A = 1$.

Barkhausen Criterion for Sustained Oscillation

The overall gain of positive feedback is given by,

$$A_f = \frac{A}{1 - \beta A}$$

Where A is internal gain and β is feedback factor.

$$\text{If } \beta A = 1 \Rightarrow A_f = \infty$$

The gain becomes infinity means that there is output without any inputs

In other words, the amplifier becomes an ~~amplifier~~ oscillator, The condⁿ is,

$$\beta A = 1$$

Total phase $= 0^\circ$ or 360°

This is known as Barkhausen Criterion for Sustained oscillation.

Hartley oscillator

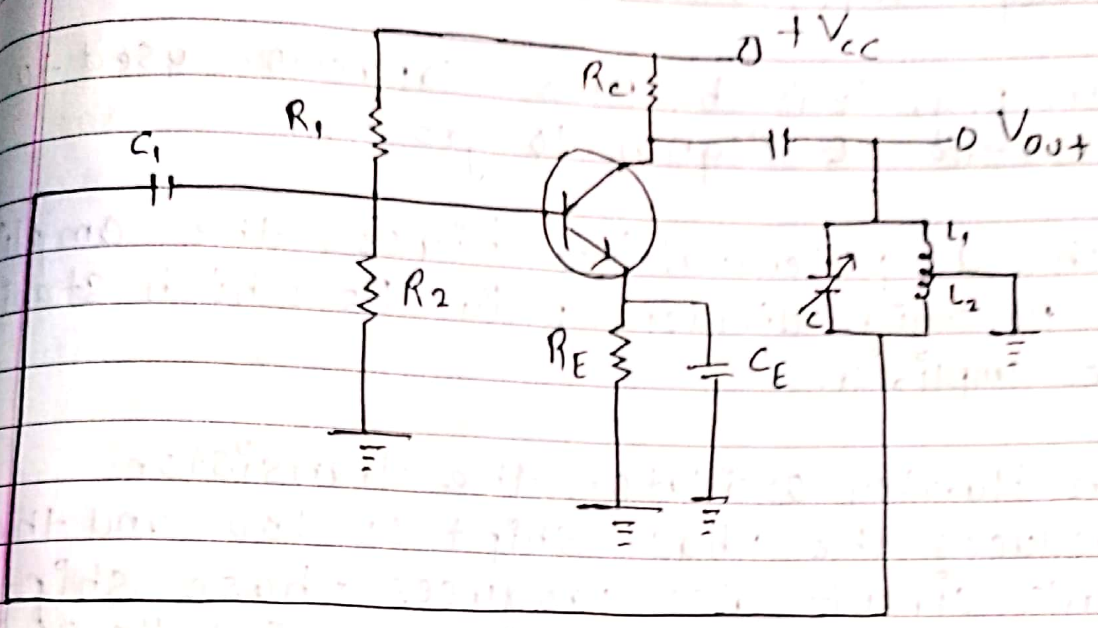

Fig: Hartely oscillator

The circuit diagram for Hartley Oscillator is as shown in figure above

It consists of common Emitter (CE) amplifier with a tank circuit where tank circuit consists of a center tapped inductor with values L_1 and L_2. A variable capacitor C is connected parallel to L_1 and L_2.

The inductor L_1 is connected to collector of transistor through coupling capacitor C_2 in Output side.

The inductor L_2 is connected to base of transistor through coupling capacitor C_1.

The feedback is applied to amplifier through the tank circuit.

In fig, C_E is by pass capacitor used to pass the ac signal to ground.

The dc potential V_{cc} biases the amplifier by potential divider of R_1 & R_2 which stabilizes the amplifier.

In Hartley oscillator, the transistor produces the phase shift of 180° and the tank circuit also produces phase shift of 180°. So the total phase shift is 360° or 0°, which is the necessary condition for oscillator.

The frequency of Hartley oscillator is,

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Where, $L = L_1 + L_2 + 2M$.

Where, M is mutual inductance of L_1 and L_2.

Colpitt's oscillator

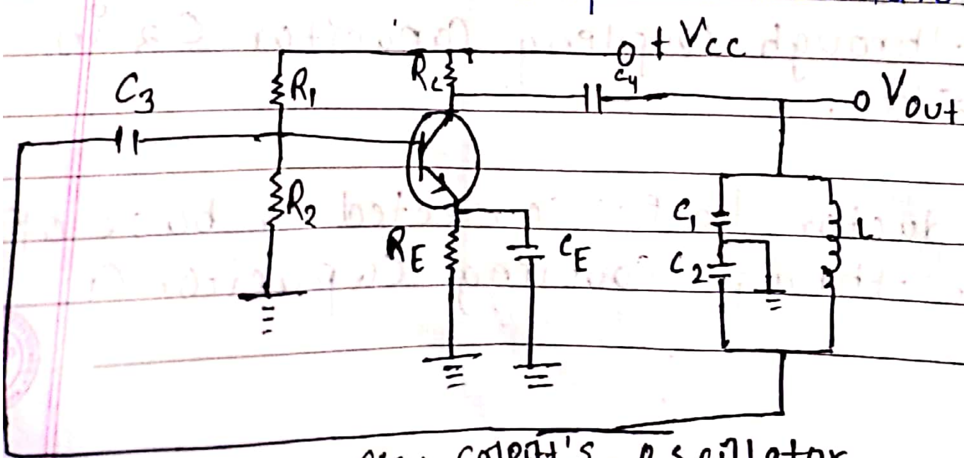

fig: Colpitt's oscillator

The essential component of colpitt's oscillator is same with that of Hartley oscillator.

In Hartley oscillator inductor is centrally tapped but in the case of colpitts oscillator two capacitors are centrally tapped.

It consists of common emitter transistor with tank circuit. In tank circuit there are centrally tapped capacitors C_1 and C_2 and an inductor L.

The potential is feedback to transistor through coupling capacitor C_3. C_1 is connected to collector through coupling capacitor C_4 (i.e, output side).

C_2 is connected to base of transistor through coupling capacitor C_3.

The collector resistor (R_C) provides the necessory load to collector. Since transistor is common emitter, the phase shift due to transistor is 180°. Also the tank circuit produces the phase shift of 180° such that the phase shift is 360° or 0°. which is necessary condition for sustained oscillation.

The frequency of colpitt's oscillator is,

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Where, $C = \frac{C_1 C_2}{C_1 + C_2}$

The minimum value of amplifier gain for maintaining oscillator is,

$$A_{min} = \frac{C_2}{C_1}$$

Phase shift Oscillator

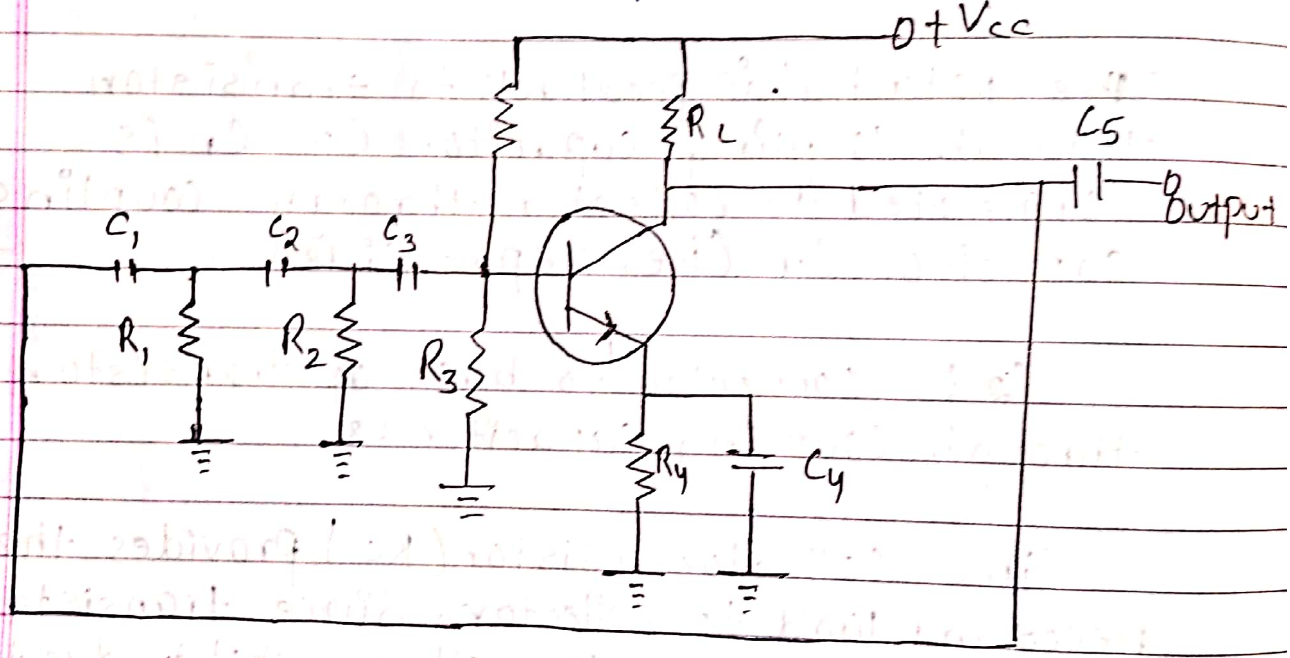

Fig: Phase shift oscillator

Above figure shows RC phase shift Oscillator it uses a three section R-C feedback network for producing a total phase shift of 180° (i.e 60° per section). Also CE amplifier produces a phase shift of 180°. Hence total phase shift become 360° or 0°

which is necessary condition for Oscillator.

The frequency of oscillation for phase Shift Oscillator is.

$$f = \frac{1}{2\pi\sqrt{6}RC} \text{ Hz}$$

Moreover it is found that value of $\beta = \frac{1}{29}$

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