Active filter

Filter is generally a frequency.

What is filter?

= The electronic filter is an ~~electroni~~ electrical or electronic circuit which allows to the passing of the signals of a predetermined frequency and rejects the all other frequency signals.

Passive filter: The filter circuit which is made by passive component like Resistor, Capacitor and inductor etc is called passive filter.

Filter are generally two types:

(i) Active filter. → Made by active component, transistor, OP-Amp

(ii) Passive filter. → Made by passive component, → R, C, L

Active filter: The filter circuit which is made by active element like transistors, Op-Amp, diodes etc are called Active filter.

Types of Active filter:

(i) Low-Pass filter.

(ii) High-Pass filter.

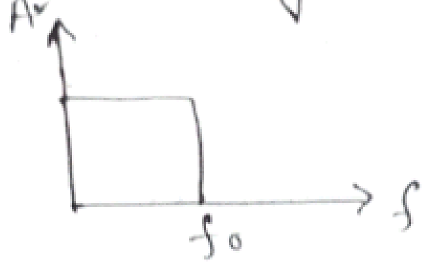
(iii) Band-Pass filter.

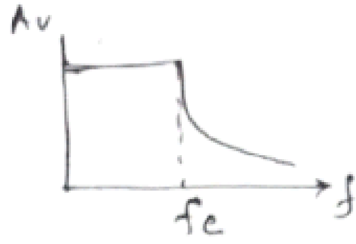
(iv) Band-stop filter

(v) All pass filter.

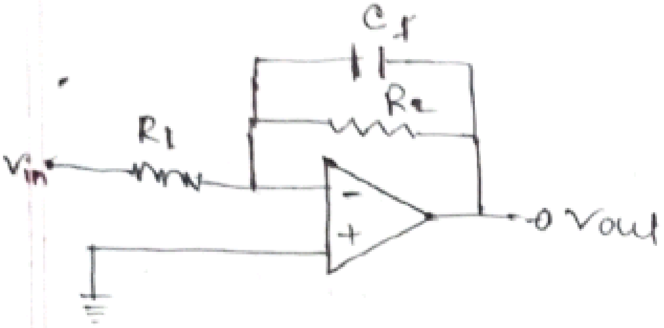
2017 - 8(b)

(i) Low Pass filter: The filter circuit which allows passing the signals having the low frequency and rejects the signals having the frequency beyond that cut-off frequency is called low-pass filter.





0 - f_0 frequency can pass.



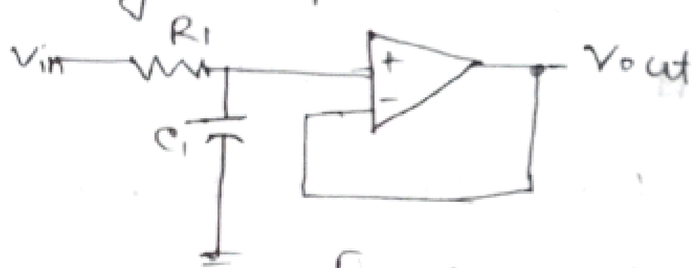
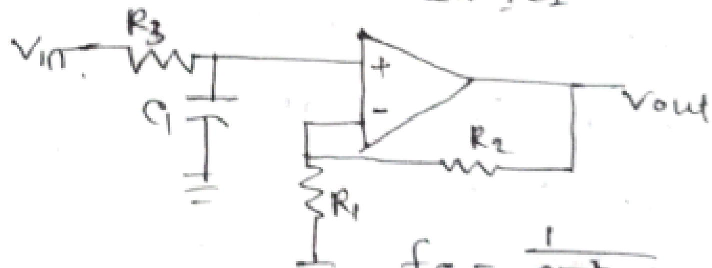


fig-a

$f_c = \frac{1}{2\pi R_1 C_1}$

Fig: c

$f_c = \frac{1}{2\pi R_2 C}$



$f_c = \frac{1}{2\pi R_3 C_1}$

fig-b

When the frequency increases above the cutoff frequency, the capacitive reactance decreases and reduces the non-inverting input voltage. The R_1C_1 lag circuit is ~~output~~ outside the feedback loop, the output voltage rolls off. As the frequency approaches infinity, the capacitor becomes a short and there is zero input voltage.

Figure-b shows another non-inverting first order low-pass filter. Although it has two additional resistor, it has the advantage of voltage gain. The voltage gain will below the cutoff frequency is given by.

Voltage gain, $A_v = \frac{R_2}{R_1} + 1$

The cutoff frequency is given by.

$$f_c = \frac{1}{2\pi R_3 C_1}$$

(imp)

Figure-c shows that an inverting first order low pass filter and its equations. At low frequency, the capacitor appears to be open and the circuit acts like an inverting amplifier with a voltage gain of

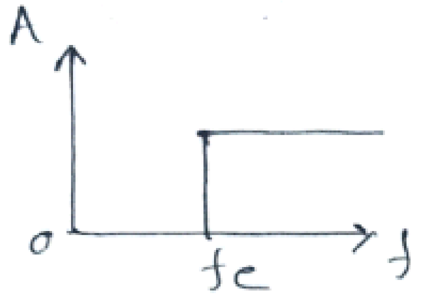
$$A_v = -\frac{R_2}{R_1}$$

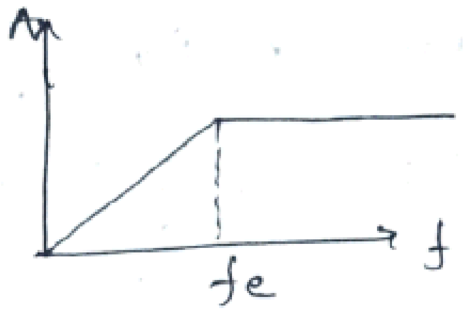
As frequency increases, the capacitive reactance decreases and reduces the impedance of the feedback branch. This impiles less voltage gain. As the frequency approches infinity, the capacitor becomes a short and there is no voltage gain. As shown in fig-c the cutoff frequency is given by

$$f_c = \frac{1}{2\pi R_2 C_1}$$

There is no other way to implement a first-order low-pass filter. A first-order stage has no resonant frequency.

High-Pass filter: The filter circuit which allows passing the signals having the high frequency ~~starting~~ and rejects the signals having the frequency below that cut-off frequency is called High-Pass filter.





fc–f frequency can pass.

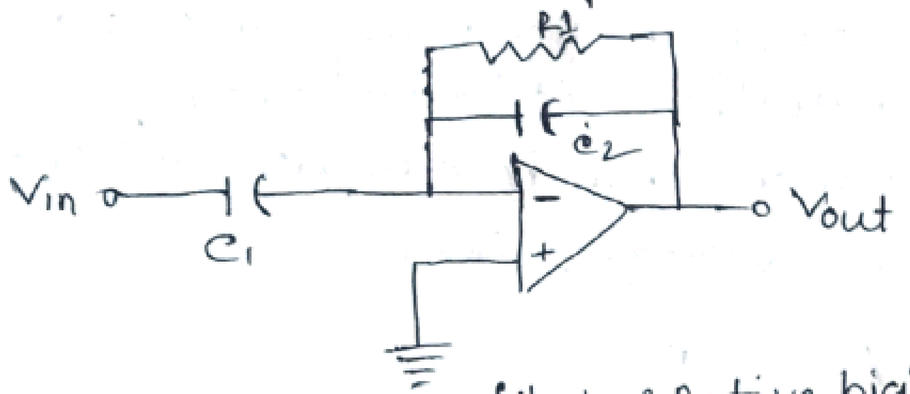


fig-b : Active high-Pass filter

Fig-b shows the simplest way to built a first-order high pass filter. The voltage gain is:

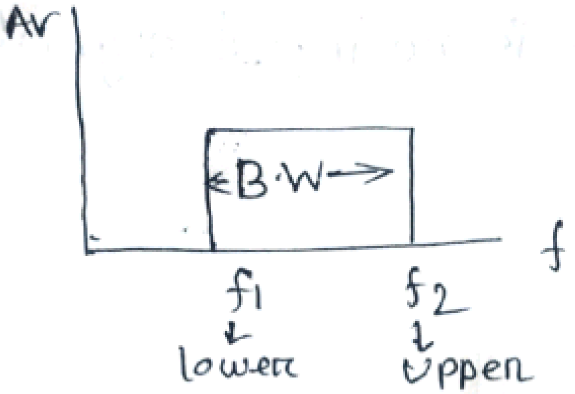
$$A_v = -\frac{C_1}{C_2}$$

The cutoff frequency is given by:

$$f_c = \cancel{\frac{1}{2\pi R_1 C_2}} \quad \frac{1}{2\pi R_1 C_2}$$

As the frrequency dearceases. the capacitive rreactance increase and everrtually rreduce the input signal and the feed back. This implies less voltage gain. As the frrequency apporoaches zerro, the capacitors become open and therre is no input signal.

Band pass filter: A band pass filter only allows those frequency within a certain band to pass through. In this sense, lowpass and high pass filters are just special types of bandpass filter.



Active band pass filter.

A band pass filter is useful when we want to tune in a radio or television signal. It is also useful in telephone communications equipment for separating the different phone conversation. A brick wall response like blocks all frequencies from zero up to the lower cutoff frequency.

Then it passes all the frequencies between the lower and upper cutoff frequences. Finally, it blocks all frequiencis above the upper cutoff frequiency with a band pass filter, the pass band is all the frequiencies between the lower and upper cutoff frequienctes. The frequaiencies below the lower cutoff frequency and above the upper cutoff frequency are the stopband. An ideal bandpass filter has zero attenuation in the passband, infinite attenuation in the stopband, and two vertical transitions.

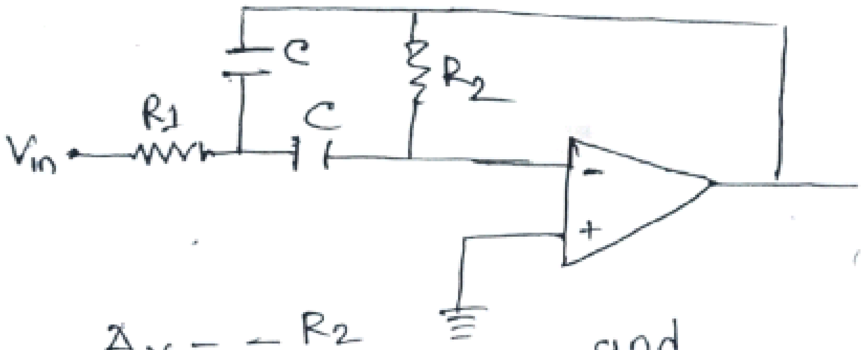
The center frequency is symbolized by and is given by the geometric avarage of the two cutoff frequencies:

$$f_0 = \sqrt{f_1 f_2}$$

The Q of a bandpass filter is defined as the center frequency divided by the bandwidth.

$$Q = \frac{f_0}{BW}$$

cutoff frequencies, $f_0 = \frac{f_1 + f_2}{2}$



$BW = f_2 - f_1$

$A_v = -\frac{R_2}{2R_1}$ and $f_0 = \frac{1}{\sqrt{f_1 f_2}}$

Cutoff, $f_0 = \frac{1}{2\pi C\sqrt{R_1 R_2}}$

$Q < 1 \rightarrow$ wide band filter.

$Q > 1 \rightarrow$ Narrow band filter.

Response of filter

2018-8(b)

 # Order of filter: The order of passive filter (n) equal the number of inductors and capacitors in the filter. The order of a active filter depends on the number of RC circuit in contains. The order of a filter is represented by n. If a passive filter has two inductors and two capacitors, then the order is $n = 4$

If an active filter contains eight RC circuit. so order $n = 8$.

2018-8(a)

Discuss the different types of filter response?

= There are four basic filter response types. These types are high pass, lowpass, band pass, and band reject

① High pass filter: A high pass filter allows only frequiencies above a certain break point to pass through. In other word, it rejects low frequency component.

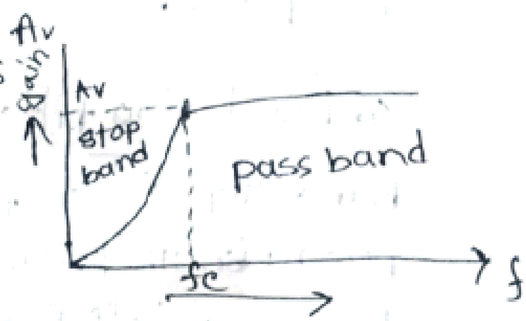


Fig. High-Pass response

2. Low-Pass filter response:

A low pass filter allows only ~~on~~ low frequency signal to pass through. While rejecting high frequency signal.

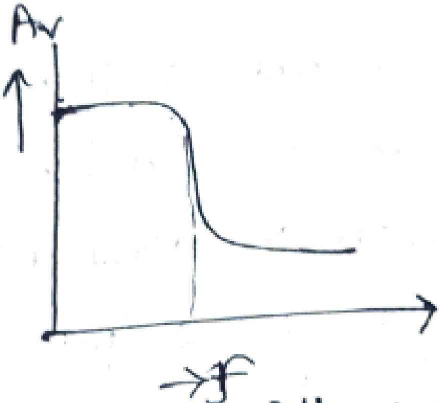


fig. low-pass filter resp

3. Band-Pass filter response:

A band pass-filter can be through of as a combination of high and low pass filters. It allows ~~the~~ frequencies within a specified range to pass.

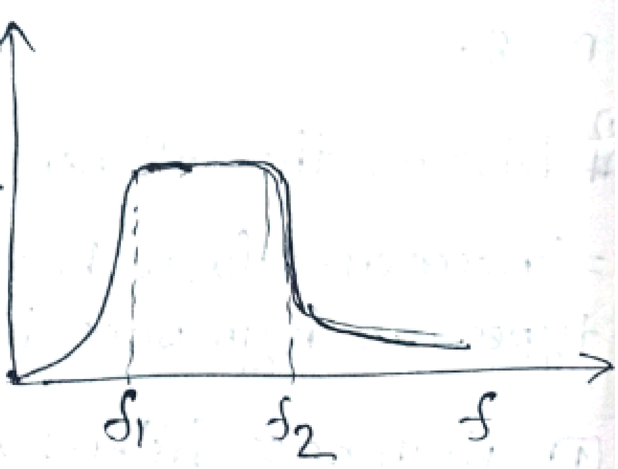


fig: Band-Pass filter resp

4. Band-stop filter response:

Band stop filter passes all frequencis from zero upto lower cutoff frequency them it blocks all the frequencies between the lower and upper cutoff frequencies, finally it passes above all frequencies of upper cutoff frequencies.

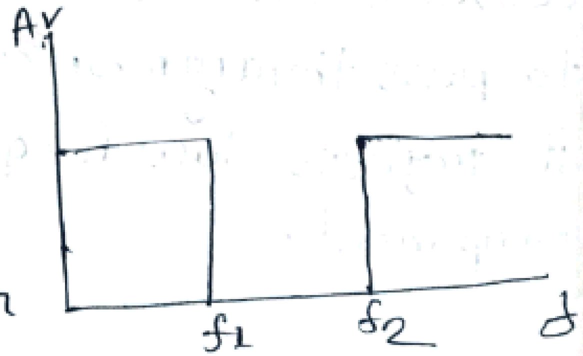


fig: Band-stop filter

Advantages of Active fiten. 2018-8(a)

1. These filters are more responsible than passive filters.
2. No resonance issue.
3. It can eliminate any harmonies.
4. Used for Voltage regulation.
5. Used for reactive power compensation.
6. It can be designed to provide some passband gain.
7. There is no leading problem.
8. Active filter using op-amp does not lead the input load
9. It does not exhibit any insertion loss.
10. It also allows isolations control of input and output imphedence.

Disadvantage of Active filter:

1. It is expensive.
2. It provides a complex control system.
3. The active filter is only suitable for low or moderate frequencies.
4. It can not handle a large amount of power.
5. It requires DC power supply for their operation.
6. This filter is limited in their frequency range.

Advantages of filter circuit:

1. By using filter we can eliminate background Noise.

2. Used in radio tuning to a specific frequency.

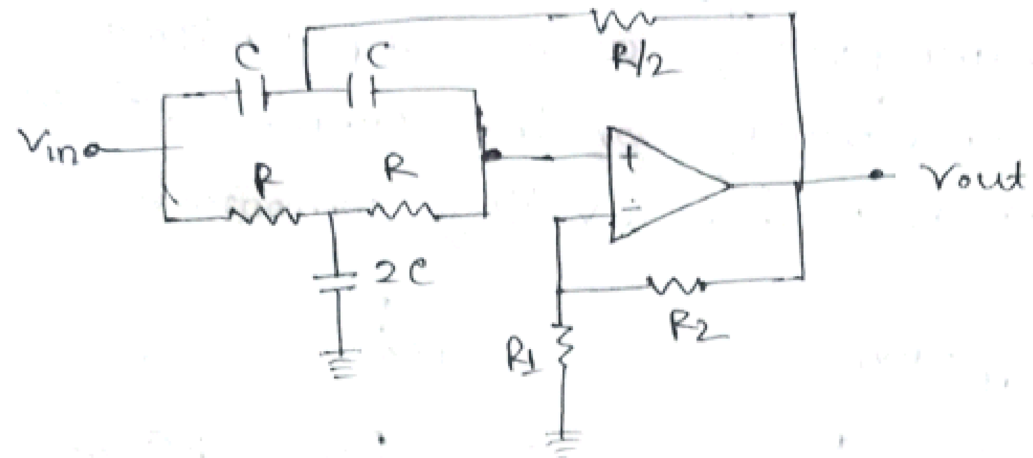
3. We can used in signal processing circuits and data conversion.

4. They are economical or cost effective.

5. Unlike passive filter circuits, Active filter circuits require power supply.

2016-4(c)

Explain the opercation of second-ordetc band-stop fittere with cirrcuit diagram?



Figurre shows sallen-key second-orden notch fitten. and At low frequency the capacitorrs are open. As a result all the input signal rreaches the non-inverting input. The cirrcuit has a pass band voltage gain of.

$$A_v = \frac{R_2}{R_1} + 1$$

At verry high frrequencies, the capacitorrs are shorrted. Again, all the input signal rreaches the non-inverting input. Between the low and high extremes in frequency there is a centre frequeney given by,

$$f = \frac{1}{2\pi RC}$$

The output voltage dnops to a very low value.

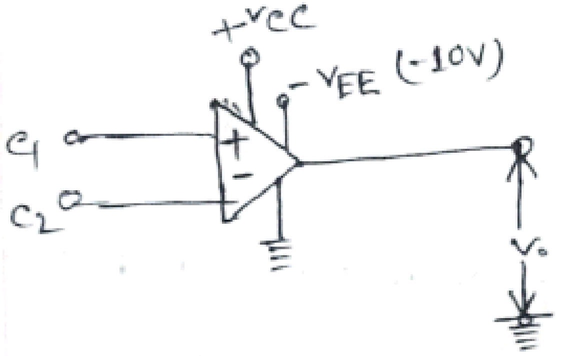
The Q of the cirrcuit, $Q = \frac{0.5}{2 - A_v}$

The voltage gain of sallen-key notch must be less than 2 to avoid oscillatorrs.

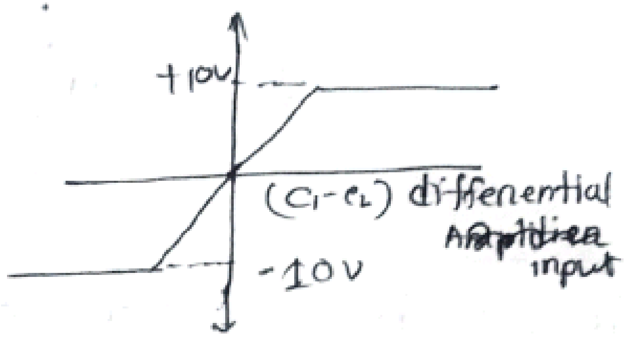
2016-4 (d)

Discuss how OP-Amp can be used as a comparator.

= The function of voltage comparator is to compare the time varying voltage at once input with a fixed reference voltage on the other. A differential amplifier can be used as a voltage comparator.



Differential Amplifier

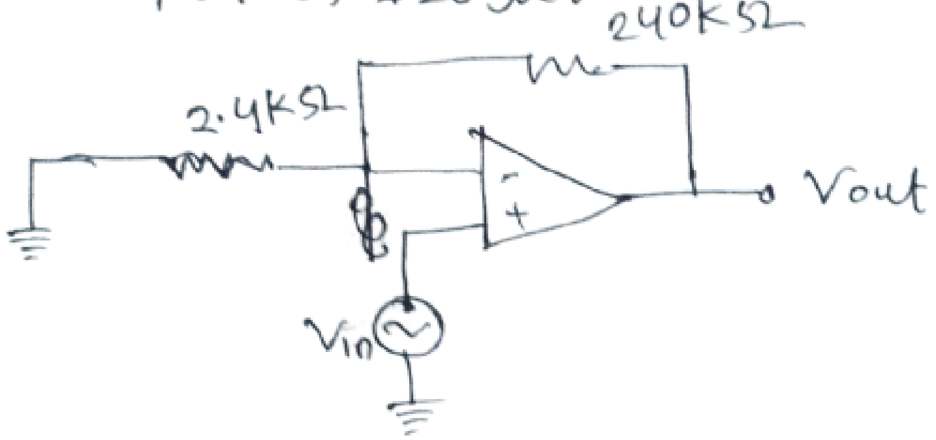


input and output graph.

Figure shows a differential amplifier. Since voltage gain of OP-Amp is very high. Output V_o will reach its positive saturation value. whenever C_i becomes slightly greater than 'R', V_o will reach its negative saturation value whenever C_i become slightly lower than R. Thus output will quickly jump form one saturation value to the other as C_i varies above and below C_1

2014 - 3(c)

Calculated the output voltage from the non-inverting amplifier circuit shown in Fig for an input of 120 μV



Here,

$R_1 = 2.4K\Omega$

$R_2 = 240K\Omega$

$V_{in} = 120\mu V$

$V_{out} = ?$

We know for non-inverting,

$$A = 1 + \frac{R_2}{R_1}$$

$$\Rightarrow \frac{V_o}{V_{in}} = 1 + \frac{240}{2.4}$$

$$\Rightarrow \frac{V_o}{120} = (101)$$

$$\Rightarrow V_o = 101 \times 120$$

$$= 12120 \mu V$$

$$=$$

2018 – 8 (d)

A band Pass filter has ~~lf~~ lower cutoff and upper cut-off frequencies, of 20 KHz and 22.5 KHz respectively. What are the bandwidth, center frequency and Q.

Well
Solution

We know,

$$BW = f_2 - f_1$$
$$= (22.5 - 20) \text{ KHz}$$
$$= 2.5 \text{ KHz}$$

$$f_0 = \sqrt{f_1 f_2}$$
$$= \sqrt{20 \times 22.5}$$
$$= 21.21 \text{ KHz}$$

$$Q = \frac{f_0}{BW} = \frac{21.21}{2.5} = 8.5$$

Here,

$f_1 = 20$ KHz

$f_2 = 22.5$ KHz

BW = 2

f_0 = ?

Q = ?

2017 – 8 (c)

A band pass filter has center frequency of 50KHz and a Q of 20. what are the cotoff frequiencies.

Solution :

$\therefore f_0 = 50\,KHz = \frac{f_1+f_2}{2}$

$\Rightarrow f_1+f_2 = 100$

$\Rightarrow f_1 = 100 - f_2$ --- ①

Here, $f_0 = 50\,KHz$

$Q = 20$

$Q = \frac{f_0}{BW}$

$BW = f_2 - f_1$

$Q = \frac{f_0}{BW} = \frac{f_0}{f_2-f_1}$

$\Rightarrow Q = \frac{f_1+f_2}{2(f_2-f_1)}$

$\Rightarrow 20 = \frac{100}{2(f_2-f_1)}$

$\Rightarrow f_2 - f_1 = \frac{50}{20}$

$\Rightarrow f_2 - 100 + f_2 = \frac{50}{20}$

$\Rightarrow 2f_2 = \frac{50}{20} + 100$

$\Rightarrow f_2 = 51.25\ KHz$

$\therefore f_1 = 100 - 51.25$

$= 48.75\ KHz$

when,

$Q > 10$

$f_0 = \frac{f_1+f_2}{2}$

when,

$Q < 10$

$f_0 = \sqrt{f_1 f_2}$

Active low-pass filter :

An active filter permits only low frequency and derives all other high-frequency component, is called low-pass filter.

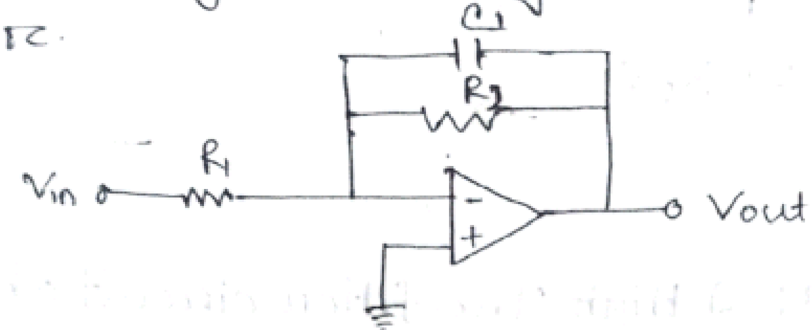


fig: active low-pass filter inverting with voltage gain

In above figure shows an inverting first order low-pass filter and its equations is

We know,

$$X_c = \frac{1}{2\pi f_c}$$

Here;
$f_c \rightarrow$ frequency
$X_c \rightarrow$ capacitive reactance

In low frequencies, the capacitor appears to be open and the circuit acts like an inverting amplifier with a voltage gain of.

$$A_v = -\frac{R_2}{R_1}$$

As the frequency increase, the capacitives reactance decreases and reduces the impedance of the feedback branch. This implies less voltage gain.

As the frequency approaches infinity, the capacitor becomes a short and there is no voltage gain. the cutoff frequency is given by.

$$f_c = \frac{1}{2\pi R_2 C_1}$$

High-Pass filter:

~~A High~~ The filter circuit which allows passing the signals having the high frequency and rejects the signal having the frequency below that cutoff frequency is called High Pass filter.

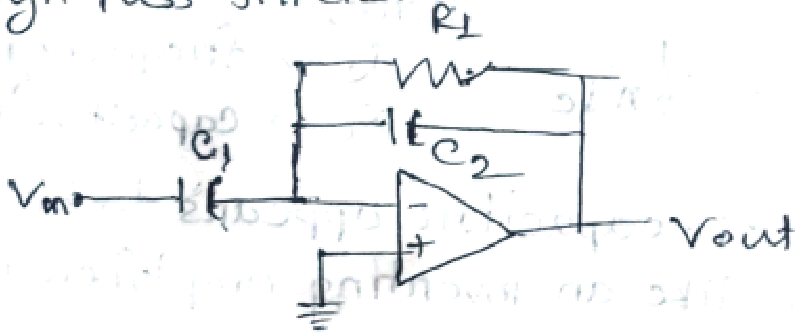


Fig: Active high-Pass filter inverting with voltage gain. first order inverting

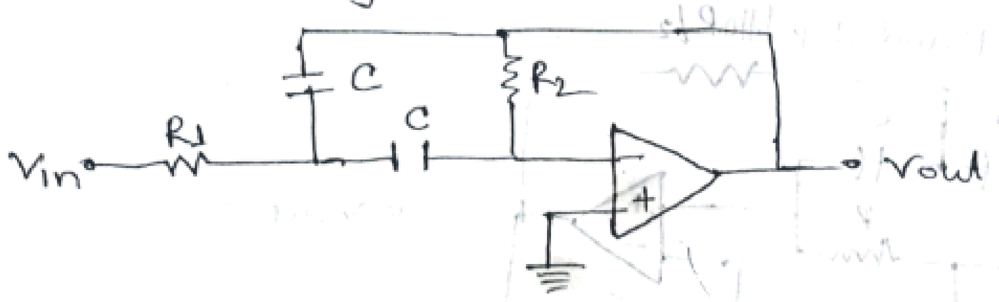
In figure shows an high-Pass filter and its equations. At high frequencies, the circuits acts like an inverting amplifier with a voltage gain of.

$$A_v = \frac{-X_{C_2}}{X_{C_1}} = \frac{-C_1}{C_2}$$

As the frequency decreases the capacitive reactance increase and eventually reduce the input signal and the feedback. This implies less voltage gain. As the frequency approaches zero, the capacitors become open and there is no input signal. Cutoff frequency is given by:

$$f_c = \frac{1}{2\pi R_1 C_2}$$

Band ~~stop~~ pass filter: A band Pass filter only allows those frequency within a certain band to pass through. In this ~~case~~ sense, low pass and high Pass filters are just special types of bandpass filter.



A band pass filter is a brick wall response like blocks all frequencies from zero up to the lower cutoff frequency. Then it passes all the frequencies between the lower and upper cutoff frequencies. Finally, it blocks all frequencies above the upper ~~cu~~ cutoff frequency. with band pass filter. An ideal bandpass filter has zero attenuation in the pass band, infinite attenuation in the stopband and two vertical transistors.

The center frequency is given by.

$f_0 = \sqrt{f_1 f_2}$ and

Bandwidth, $BW = f_2 - f_1$

$Q < 10$ and

$Q > 10$, $f_0 = \frac{f_1 + f_2}{2}$

$$Q = \frac{f_0}{BW}$$

when. Q is less than 1, the filter has wide band filter. and,
when Q is greater than 1, the filter has Narrow band respose.

Band Stop filter: When a low pass filter and a high pass filter are parallelly connected with a adder circuit is known as a Band stop filter

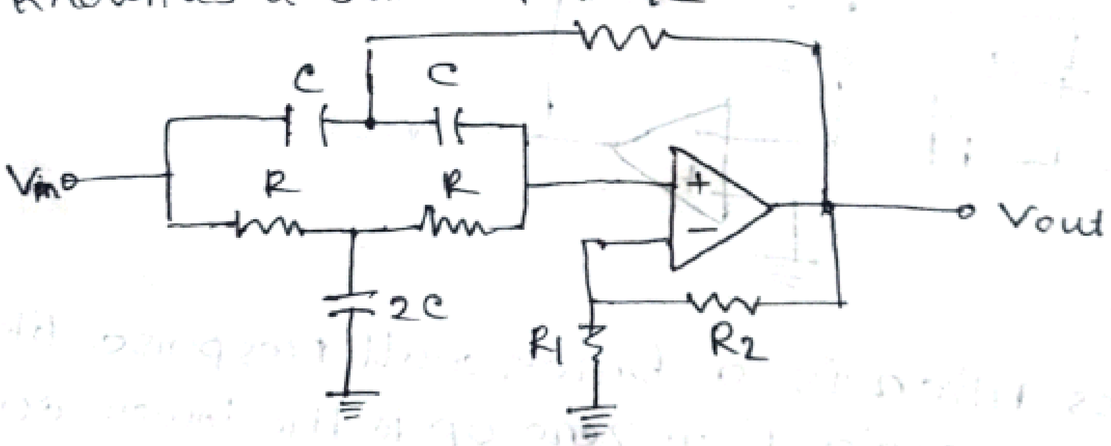


figure shows a Sallen-key Second order notch filter. At low frequencies all capacitors are open. As a result, all input signal reaches the non-inverting input. So the Pass band voltage gain is,

$$A_v = 1 + \frac{R_2}{R_1}$$

At very high frequency, the capacitors are shorted, Again, All input signal stay in non-inverting input. Now, there is a center frequency given by.

$$f_o = \frac{1}{2\pi RC}$$

At this frequencies, the feedback signal returns with the correct amplitude and phase to attenuate the signal on the non-inverting input.

The Q-~~of~~ the circuit is given by.

$$Q = \frac{0.5}{2 - A_v}$$

Example: what are the voltage gain, center frequency and Q for the bandstop filter. if $R = 22K\Omega$, $C = 120nF$ $R_1 = 13K\Omega$. $R_2 = 10K\Omega$.

Ans: we know,

$$A_v = 1 + \frac{R_2}{R_1} = 1 + \frac{10}{13} = 1.77$$

Center frequency.

$$f_o = \frac{1}{2\pi RC}$$

$$= \frac{1}{2\pi \times 22\times10^3 \times 120\times10^{-9}}$$

$$= 60.3\ Hz$$

Here,

$R_1 = 13K\Omega$

$R_2 = 10K\Omega$

$A_v = ?$

$f_o = ?$

$R = 22K\Omega$
$= 22\times10^3\ \Omega$

$C = 120\ nF$
$= 120\times10^{-9}$

and,

$$\varphi = \frac{0.5}{2 - A_v}$$

$$= \frac{0.5}{2 - 1.77}$$

$$= 2.17$$

* What is oscillators?

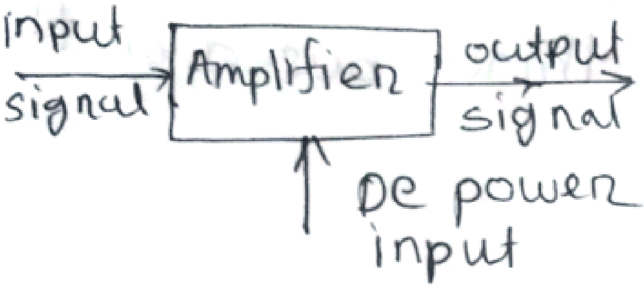
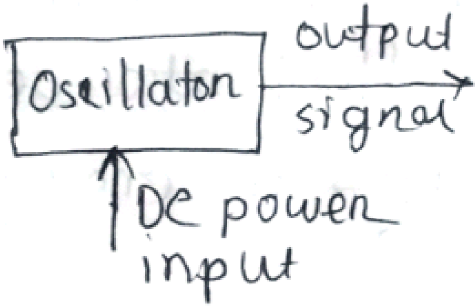
= An oscillator is a mechanical or electronic device that works on the principles of oscillation: a periodic fluctuation between two things based on the changes in energy.

* Discuss the advantages of oscillators?

1. Wien Bridge Oscillator produces highly stable and low distorted output.
2. Modification of frequency of Oscillation is possible
3. Less noise is produced.
4. They can be designed at low cost.

* What are the difference between oscillators and amplifier?

Amplifier	Oscillators.
1. Amplifier doesnot generate any periodic signal.	1. The oscillator is generating periodic electronic signal.
2. Amplifier uses negative feedback.	2. Oscillators uses positive feedback
3. The amplifier provides amplified signal.	3. Oscillator is gives oscillatory signal.

4. Amplifier operates as a multiplier.	4. Oscillator operates as a source
5. 	

Hartley Oscillator:

Phase-shift Oscillators: RC:

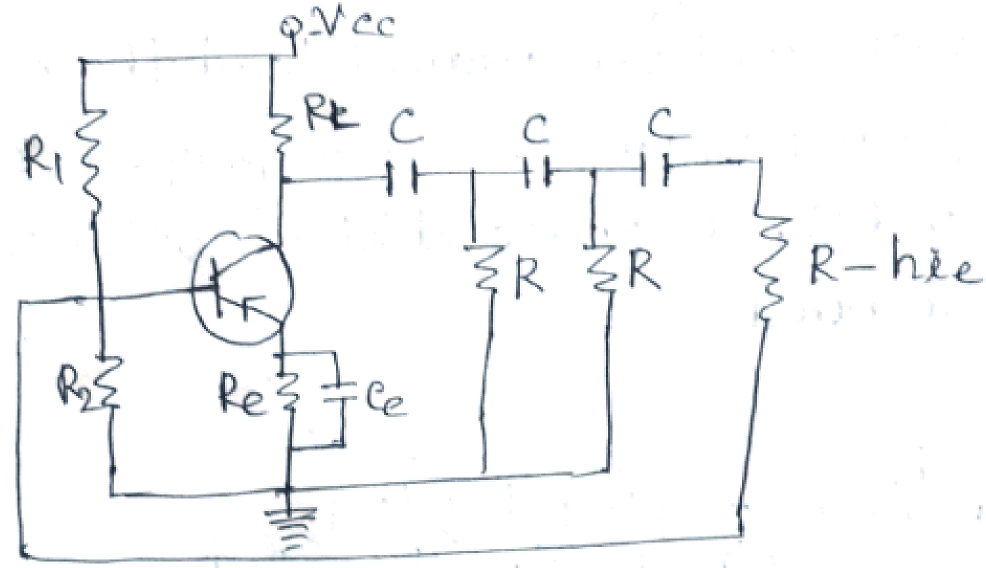
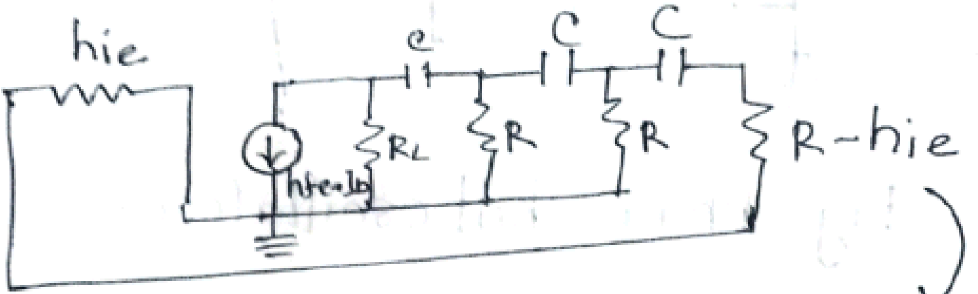
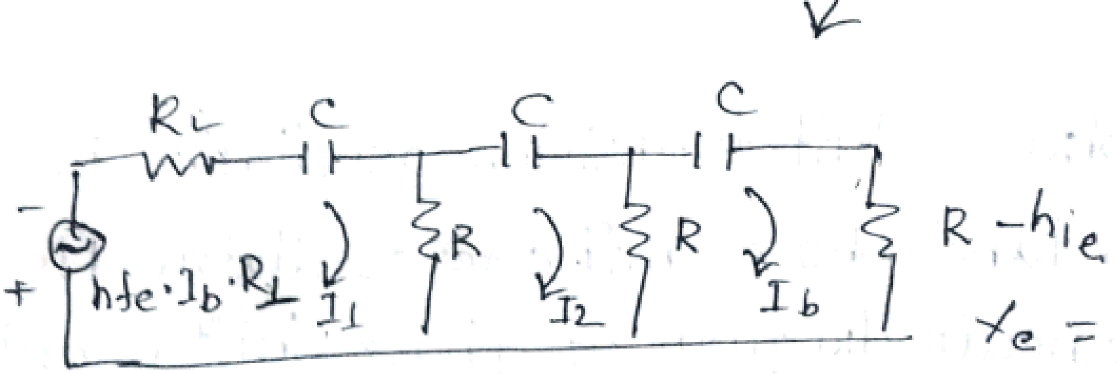


Fig: Phase-shift oscillator.

The phase shift transistor oscillator is similar to vacuum tube phase shift ~~osic~~ oscillator. Figure shows the circuit diagram of phase shift oscillator. To obtain a positive feedback essential for oscillation the frequency determining circuit must introduce a phase change of 180°. This phase shift of 180 is obtained with three cascade sections CR, CR, CR each shifting the signal by ~~180~~ 60°. The phase shift comes about because R and C provides a current which leads the applied voltage by certain angle. The smaller is the capacitance more will the current lead the voltage for a given resistance. with a proper choice of R and C, a phase shift of 60° per section is achieved.





$X_c = \frac{1}{J\omega C}$

Fig: Equivalent circuit of Phase-shift oscillator

Applying Kirchoff's Voltage Law for three loops.

$$R_L \cdot I_1 + \frac{1}{J\omega C} \cdot I_1 + RI_1 + h_{fe} I_b R_L - I_2 R = 0$$

$$\Rightarrow (R_L + \frac{1}{J\omega C} + R)I_1 - RI_2 + h_{fe} I_b R_L = 0 \quad \text{--- (i)}$$

And. $$-RI_1 + (2R + \frac{1}{J\omega C})I_2 - RI_b = 0 \quad \text{--- (ii)}$$

And,

$$-RI_2 + \left(2R + \frac{1}{j\omega c}\right) I_b = 0 \quad \text{--- (iii)}$$

∴ The determinant form of above equations is given by

$$\begin{vmatrix} R + R_L + \frac{1}{j\omega c} & -R & h_{fe} R_L \\ -R & \left(2R + \frac{1}{j\omega c}\right) & -R \\ 0 & -R & \left(2R + \frac{1}{j\omega c}\right) \end{vmatrix} = 0$$

(short cut করে)
মুখস্ত রাখ বিকল্পসূত্র)

$$\omega^2 = \frac{1}{C^2 (6R^2 + 4RR_L)}$$

$$\therefore \omega = \frac{1}{C\sqrt{6R^2 + 4RR_L}}$$

$$\therefore f = \frac{\omega}{2\pi} = \frac{1}{2\pi C\sqrt{6R^2 + 4R \cdot R_L}}$$

Hartley oscillator:

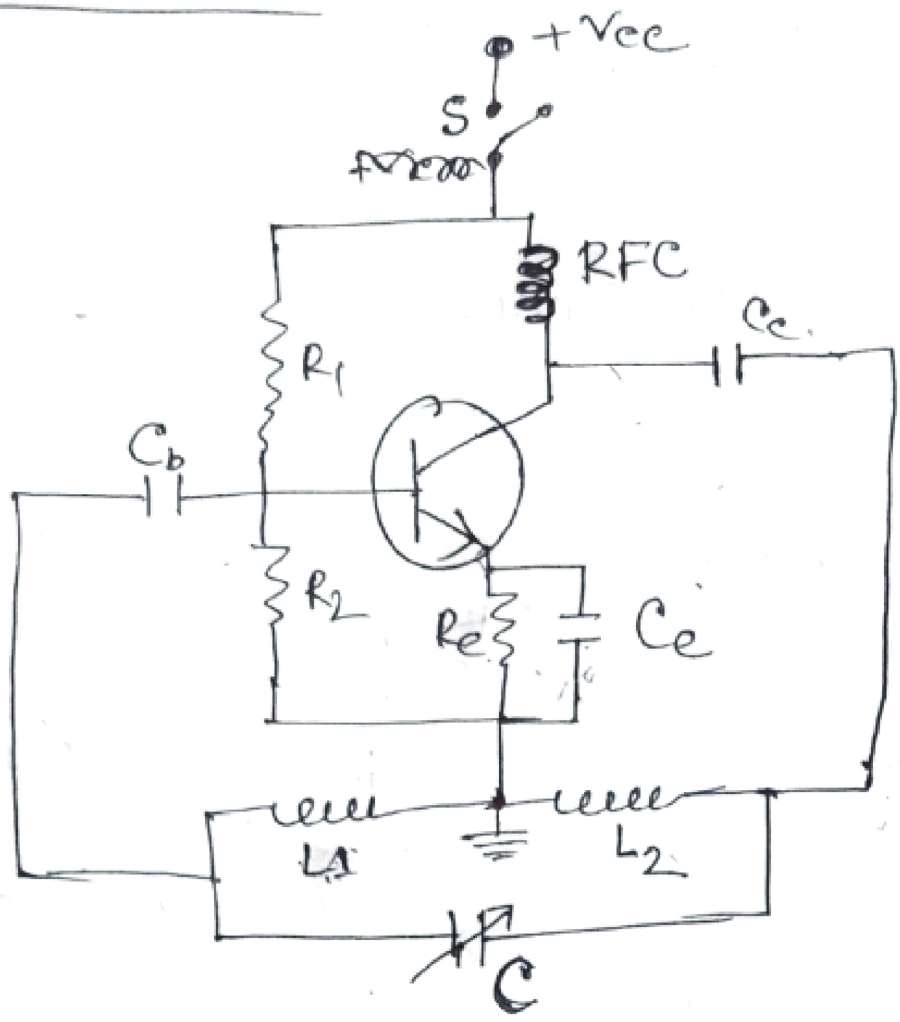


Fig-01: Hartley oscillator.

Circuit Operation: When the switch S is closed, collector currents starts rising and charges the capacitor. When capacitor C is fully charged, it discharges through coils L_1 and L_2. Now damped harmonic oscillators are setup in the tank circuit. The oscillations across L_1 are applied to the input

circuit (base emitter junction) and appear in the amplified from in the output circuit (collector circuit).
Feedback of energy from collector-emitter circuit to the base-emitter circuit is accomplished by means of mutual inductance between L_1 and L_2. In this way energy is continously supplied to the tank circuit to overcome the losses occuring in it. So, continuous undamped output is obtained.

* Colpitt's Oscillators:

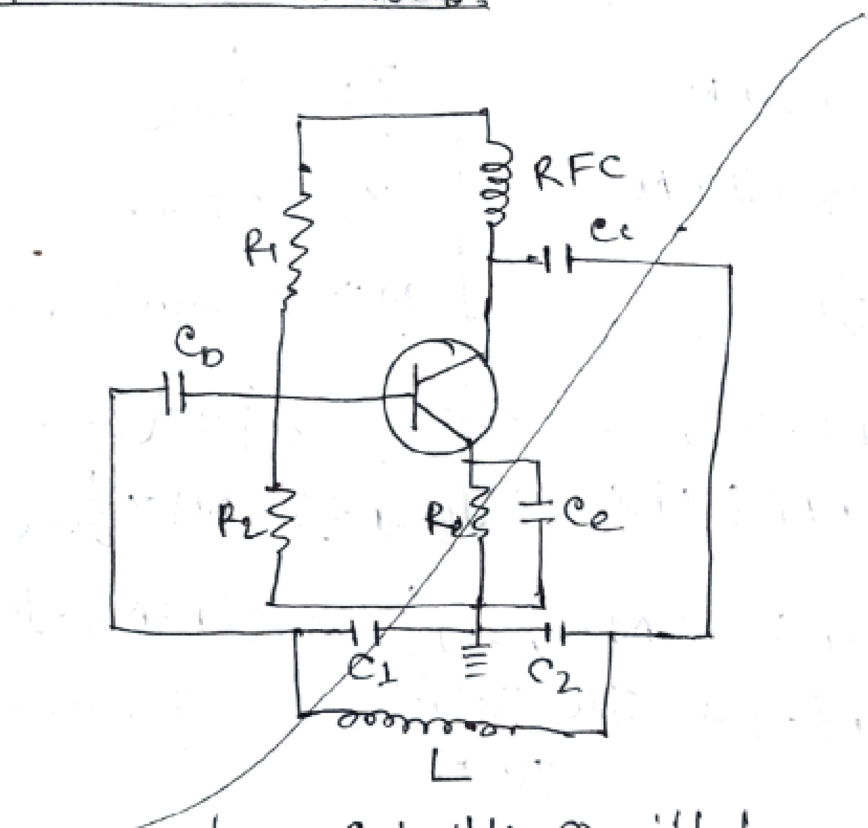


fig: Colpitt's Oscillator

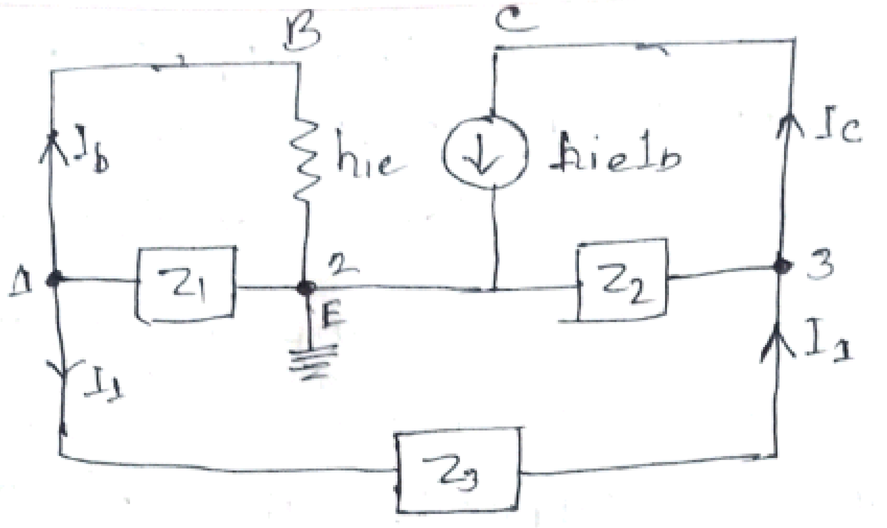


Fig: General equivalent circuit of Hartly oscillator.

Hybrid equivalent circuit,

$$h_{ie}(Z_1+Z_2+Z_3)+Z_1Z_2(1+h_{fe})+Z_1Z_3=0$$

$Z_1 = J\omega L_1 + J\omega M$

$Z_2 = J\omega L_2 + J\omega M$

$Z_3 = \frac{1}{J\omega C}$

$X_C = \frac{1}{2\pi f_c}$

$X_L = 2\pi f_c$

M = Mitual inductance.

$$\therefore h_{ie}\{J\omega L_1 + J\omega L_2 + 2J\omega M + \frac{1}{J\omega C}\} + \{J\omega L_1 + J\omega M\}(J\omega L_2 + J\omega M)(1+h_{fe}) + (J\omega L_1 + J\omega M)\times\frac{1}{J\omega C} = 0$$

$$\Rightarrow h_{ie}\{J\omega(L_1+L_2+2M-\frac{1}{\omega^2 C})\} + J\omega(L_1+M).J\omega(L_2+M)(1+h_{fe}) + \frac{J\omega(L_1+M)}{J\omega C} = 0 \quad [\text{where}, J^2=-1]$$

$$= h_{ie}\{J\omega(L_1+L_2+2M-\frac{1}{\omega^2 C}) - \omega^2(L_1+M)(L_2+M)(1+h_{fe}) + \frac{L_1+M}{C} = 0$$

$$\therefore h_{ie} \cdot j\omega \left(L_1 + L_2 + 2M - \frac{1}{\omega^2 C}\right) = 0$$

$$\left\{L_1 + L_2 + 2M - \frac{1}{\omega^2 C}\right\} = 0$$

$$\Rightarrow L_1 + L_2 + 2M = \frac{1}{\omega^2 C}$$

$$\Rightarrow \omega^2 = \frac{1}{(L_1 + L_2 + 2M)\, C}$$

$$\therefore \omega = \frac{1}{\sqrt{(L_1 + L_2 + 2M) \cdot C}}$$

$$\therefore 2\pi f = \frac{1}{\sqrt{(L_1 + L_2 + 2M) \cdot C}}$$

$$\therefore f = \frac{1}{2\pi \sqrt{(L_1 + L_2 + 2M) \cdot C}}$$

And

$$-\omega^2 (L_1 + M)(L_2 + M)(1 + h_{fe}) + \frac{L_1 + M}{C} = 0$$

$$\Rightarrow \omega^2 (L_1 + M)(L_2 + M)(1 + h_{fe}) = \frac{L_1 + M}{C}$$

$$\Rightarrow \omega^2 (L_2 + M)(1 + h_{fe}) = \frac{1}{C}$$

$$\Rightarrow 1 + h_{fe} = \frac{1}{\omega^2 C (L_2 + M)}$$

$$\Rightarrow 1 + h_{fe} = \frac{L_1 + L_2 + 2M}{L_2 + M} \quad [\text{using } \omega^2]$$

$$\Rightarrow h_{fe} = \frac{L_1 + L_2 + 2M - L_2 - M}{L_2 + M}$$

$$\therefore h_{fe} = \frac{L_1 + M}{L_2 + M}$$

Example : 1

where,

$L_1 = 100 \mu H = 100 \times 10^{-6}$

$L_2 = 1000 \mu H = 1000 \times 10^{-6}$

$M = 20 \mu H = 20 \times 10^{-6}$

$C = 20\ PF = 20 \times 10^{-12}$

We know that

$$f = \frac{1}{2\pi} \times \frac{1}{\sqrt{(L_1 + L_2 + 2M) \cdot C}}$$

$$= \frac{1}{2\pi} \times \frac{1}{\sqrt{(100 + 1000 + 20 \times 2) \times 10^{-6} \cdot 20 \times 10^{-12}}}$$

$$= \frac{1}{2\pi} \times \frac{1}{(\sqrt{1140 \times 10^{-6} \times 20 \times 10^{-12}}}$$

$= 1052\ KHz$

Colpitt's Oscillator :

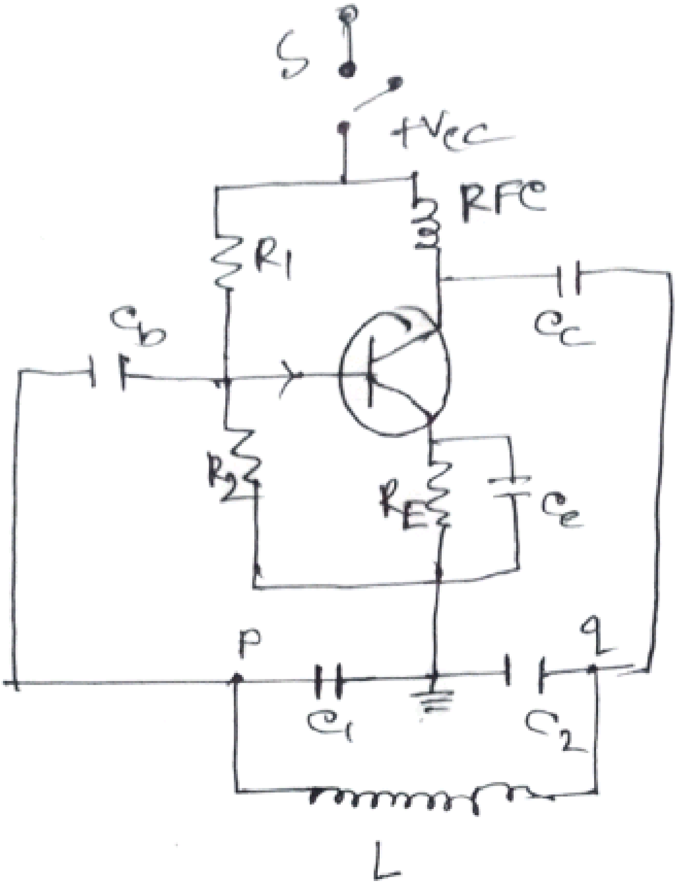


fig: Colpitt's Oscillator.

Circuit operation: When the switch S is closed, the capacitors C_1 and C_2 are charged. These capacitors are discharged through the inductance L and thereby set up damped harmonic oscillators in the tank circuit. The oscillations across C_1 are applied to the base - emitter junction and appears in the amplified form in the collector circuit and supply losses to the tank circuit. The amount of feedback depends upon the relative capacitance values of C_1 and C_2. Higher is the value of C_1 smaller is the feedback.

~~Now the switch~~

Now, we shall show that the energy supplied to the tank circuit is in phase. ~~for~~ with the generator oscillators. Hence the capacitors C_1 and C_2 act as an alternating voltage divider. So, points p and q are 180° out of phase. Further, we know that a CE transistor produces a phase change of 180° between input voltage and output voltage. Thus a total phase change of 360° occurs. In this way, continous undamped oscillators are produced.

* $$f = \frac{1}{2\pi}\sqrt{\left(\frac{1}{LC_s} + \frac{1}{AC_1C_2}\right)}$$

$$f = \frac{1}{2\pi}\sqrt{\left\{\frac{C_1+C_2}{LC_1C_2}\right\}} \rightarrow \text{[Math করার জন্য]}$$

H

Tank circuit diagram :

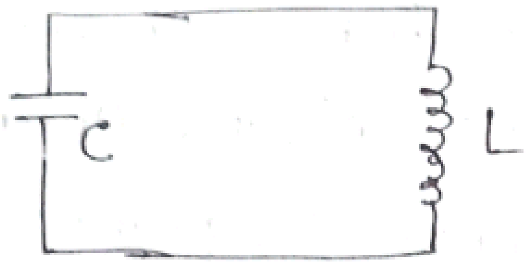
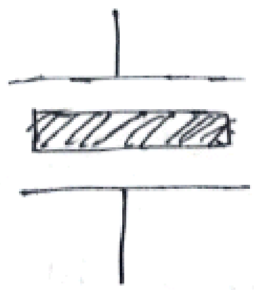


Fig: tank circuit

The tank circuit consists of an inductance coil in parallel with a capacitor. The frequency oscillations in the circuit depend upon the values of Inductance and capacitance. This is given by where L is the inductance of Induction coil and C is the capacitance of the capacitor

Crystal Oscillator : [Math আসবে]



Symbol

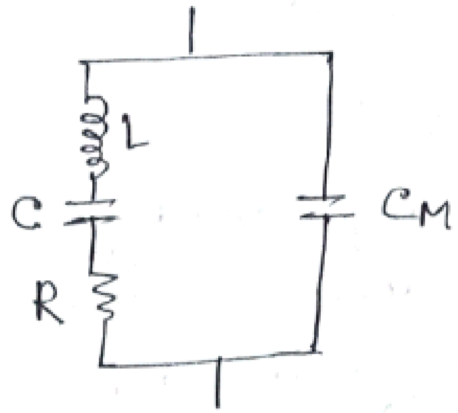


Fig: Equivalent circuit for crystal oscillator.

$$* \quad f_p = \frac{1}{2\pi}\sqrt{\frac{C+C_M}{LCC_M}} \quad \text{and} \quad f_s = \frac{1}{2\pi\sqrt{LC}}$$

Example-1 : where, $L = 1\,H$; $C = 0.01\,pF$

$= 0.01 \times 10^{-12}\,F$

$C_M = 20\,pF$

$= 20 \times 10^{-12}\,F$

$R = 1000\,\Omega$

We know that,

$$f_s = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{1 \times 0.01 \times 10^{-12}}}$$

$$= 1589 \times 10^{3}\,Hz = 1589\,KHz$$

$$f_p = \frac{1}{2\pi}\sqrt{\frac{C+C_M}{CC_ML}} = \frac{1}{2\pi}\sqrt{\frac{0.01 \times 10^{-12} + 20 \times 10^{-12}}{1 \times 0.01 \times 10^{-12} \times 20 \times 10^{-12}}}$$

$$= 1590 \times 10^{3}\,Hz = 1590\,KHz$$

* Mention the advantages and disadvantages of Colpitt's oscillator.

Advantage.

The one big advantages of this oscillator is that it's performance remains very good even the high frequency. This type of oscillator have the capacity to produce more purer waves. This oscillator generally also have the wide range of operation capacity.

Disadvantage:

The one main disadvantages is its hard to construct. Whenever the capacitor value change it becomes more difficult to adjust feedback Because of the circuit' bulkiness the cost increases also

* Mention the advantages and disadvantages of Colpitt's oscillators.

Advantages:

~~The~~ 1. Good wave purity sinusoidal. waveform.

2. Fine performen at high frequency.

3. Wide operation range 1 to 60 MHz.

Disadvantages:

1. Poor isolation

2. It is difficult to design.

Where, (18)

$L = 1\ H$

$C = 0.01\ pF$
$= 0.01 \times 10^{-12}\ F$

$R = 1000\ \Omega$, $C_M = 20\ pF$
$= 20 \times 10^{-12}\ F$

We know that,

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

$$= \frac{1}{2\pi\sqrt{1 \times 0.01 \times 10^{-12}}} = 1591\ KHz$$

$$f_p = \frac{1}{2\pi}\sqrt{\frac{C + C_M}{C \cdot C_M L}} = \frac{1}{2\pi}\sqrt{\frac{0.01 \times 10^{-12} + 20 \times 10^{-12}}{1 \times (0.01 \times 10^{-12} \times 20 \times 10^{-12})}}$$

$$= 1591\ KHz$$

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{C_1+C_2}{LC_1C_2}} \rightarrow \text{colpitt's}$$

$$f = \frac{1}{2\pi\sqrt{(L_1+L_2+2M)\cdot C}}$$

where,

$L_1 = 100\,\mu H$
$= 100\times10^{-6}\,H$

$L_2 = \cancel{10\,mH}\ 1\,mH = 1\times10^{-3}$
$= \cancel{1\times10^{-3}}\,H$
$= 1000\times10^{-6}\,H$

$M = 20\,\mu H$
$= 20\times10^{-6}$

$C = 20\,pF$
$= 20\times10^{-12}\,F$

$$\therefore f = \frac{1}{2\pi\sqrt{(100\times10^{-6}+1\times10^{-3}+20\times2\times10^{-6})\cdot 20\times10^{-12}}}$$

$= 1054.\ KHz$

Ex-2:

$$f = \frac{1}{2\pi\sqrt{(L_1+L_2+2M)\cdot C}}$$

$$= \frac{1}{2\pi\sqrt{(L_1+L_2)\cdot C}}$$

$$\Rightarrow \cancel{(150-50)} = \frac{1}{2\pi\sqrt{(L_1+L_2)\cdot C}}$$

$$\Rightarrow 150\times10^3 = \frac{1}{2\pi\sqrt{(L_1+L_2)\cdot 450\times10^{-12}}}$$

$$\Rightarrow \sqrt{L_1+L_2} = \frac{1}{2\pi\times150\times10^3\times\sqrt{450\times10^{-12}}}$$

$$\Rightarrow L_1+L_2 = \sqrt{0.05}$$

$$= 0.225\ H$$

$$= 223.6\ mH$$

$$\therefore \frac{L_2}{L_1} = \frac{h_{fe}}{\Delta h_e}$$

$$\Rightarrow L_2 = \frac{50}{0.5} = 100L_1$$

$$\therefore L_1 + 100L_1 = 223.6\ mH$$

$$\therefore L_1 = 2.21\ mH$$

$$\therefore L_2 = 100\times2.2 = 221.4\ mH$$

Example-01: colpitt's

$$f = \frac{1}{2\pi}\sqrt{\frac{C_1 + C_2}{L C_1 C_2}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{0.001\times10^{-6} + 0.01\times10^{-6}}{15\times10^{-6}\times0.001\times10^{-6}\times0.01\times10^{-6}}}$$

$$= 1362.9\ KHz$$

Example-01: Crystal

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

$$= \frac{1}{2\pi\sqrt{1\times0.01\times10^{-12}}}$$

$$= 1591.5\ KHz$$

$$f_p = \frac{1}{2\pi}\sqrt{\frac{C + C_M}{L C C_M}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{0.01\times10^{-12} + 20\times10^{-12}}{1\times0.01\times10^{-12}\times20\times10^{-12}}}$$

$$= 1591.9\ KHz$$

$\underline{\underline{6}}$ $f = \dfrac{1}{2\pi C\sqrt{6R^2 + 4RR_L}}$

$= \dfrac{1}{2\times\pi\times 0.02\times 10^{-6}\sqrt{6\times(3.2\times 10^{3})^{2} + 4\times 3.2\times 10^{3}\times 0.02\times 10^{-6}}}$

$= 1015\,KHz.$

$\boxed{\dfrac{L_2}{L_1} = \dfrac{h_{fe}}{h_{e}} = \dfrac{50}{0.5} = 100}$

$\underline{\underline{8}}$ $f = \dfrac{1}{2\pi}\sqrt{\dfrac{C_1 + C_2}{L_e C_1 C_2}}$

$\Rightarrow 16\times 10^{6} = \dfrac{1}{2\pi}\sqrt{\dfrac{C_1+C_2}{10\times 10^{-6} C_1 C_2}}$;

$\Rightarrow \sqrt{\dfrac{C_1+C_2}{C_1 C_2}} = \dfrac{1}{2\pi\times 16\times 10^{6}\times\sqrt{10\times 10^{-6}}}$

$\dfrac{C_1+C_2}{C_1 C_2} = 1.77\times 10^{-3}$

$\therefore \dfrac{C_2}{C_1} = \dfrac{h_{fe}}{h_{e}} = 100$

$C_2 = 100\,C_1$

$\cancel{1000}$ $\dfrac{101\,C_1}{100\,C_1^2} = 1.77\times 10^{-3}$

$\Rightarrow C_1 = \dfrac{101}{100\times 1.77\times 10^{-3}}$

$= C_1 = 569.47$

~~Multivib~~

Multivibrator : An electronic device produces that ~~non-sinusoidal~~ a non-sinusoidal waveform as it's output is known as multivibrator. The generated non-sinusoidal waveform are basically a square wave form, rectangular waveform, triangular waveform sawtooth wave, or ramp wave etc.

Multivibrator : An electronice device produces that a non-sinusoidal waveform as its output is known as multivibrator. The generated a non-sinusoidal wave are basically square wave, rectangular wave, tryangular wave, sawtooth ware and ramp wave etc.

There are three catagories of multibibrator.

(1) Monostable : A Monostable is a ~~mul~~ type of multivibrator circuit which the output is only one stable state. It is known as one-shot multivibrator. Monostable multivibrator circuit. the output pulse duration determine the RC circ. time constant and given by

$1.1 * R * C$

Astable multibibraton - Astable multivribraton is often called a free running multivibraton Astable multivibraton circuit which out has No stable stage. It is ~~[illegible]~~ type of re-generative oscillators.

Bistable : Bistable multivibraton is a circuit with two stable state output. Generally a switch is required for toggling between the high and low state of the output.

Monostable:

$$UTP = \frac{V_{cc}}{3}$$

$$LTP = \frac{2V_{cc}}{3}$$

$$W = 1.1 \times R \times C$$

Astable

$$W = 0.693(R_1+R_2)C$$

$$T = 0.693(R_1+2R_2)C$$

$$D = \frac{R_1+R_2}{R_1+2R_2}$$

$$f = \frac{1.44}{(R_1+2R_2)\cdot C}$$