TUNED AMPLIFIERS

- Tank circuits.
- Analysis of single tuned amplifier, Double tuned, stagger tuned amplifiers.
- Instability of tuned amplifiers, stabilization techniques, Narrow band neutralization using coil, Broad banding using Hazeltine neutralization,
- Class C tuned amplifiers and their applications. Efficiency of Class C tuned Amplifier.
- Astable multivibrators, monostable and bistable multivibrator using similar and complementary transistors, speed up capacitors,Schmitt trigger circuits.

Tuned Amplifier

- Definition

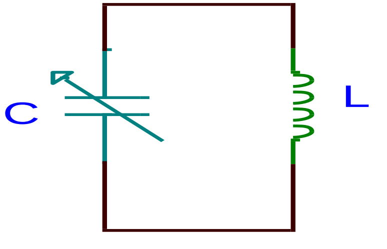
  - An amplifier circuit in which the load circuit is a tank circuit such that it can be tuned to pass or amplify selection of a desired frequency or a narrow band of frequencies, is known as Tuned Circuit Amplifier.

Tuned Amplifier Characteristics

- Tuned amplifier selects and amplifies a single frequency from a mixture of frequencies in any frequency range.
- A Tuned amplifier employs a tuned circuit.
- It uses the phenomena of resonance, the tank circuit which is capable of selecting a particular or relative narrow band of frequencies.
- The centre of this frequency band is the resonant frequency of the tuned circuit .
- Both types consist of an inductance L and capacitance C with two element connected in series and parallel

Resonance Circuits

- When at particular frequency the inductive reactance became equal to capacitive reactance and the circuit then behaves as purely resistive circuit.
- This phenomenon is called the resonance and the corresponding frequency is called the resonant frequency.



Tuned circuit

Classification of Tuned Amplifier

Tuned Amplifiers

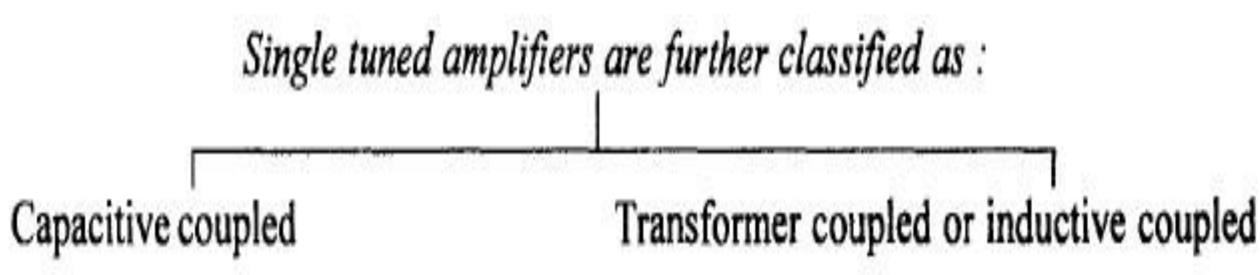
Small Signal

- To amplify low RF signals
- Power output is low
- Operated in class A
  - Single tuned
  - Double tuned
  - Staggered tuned

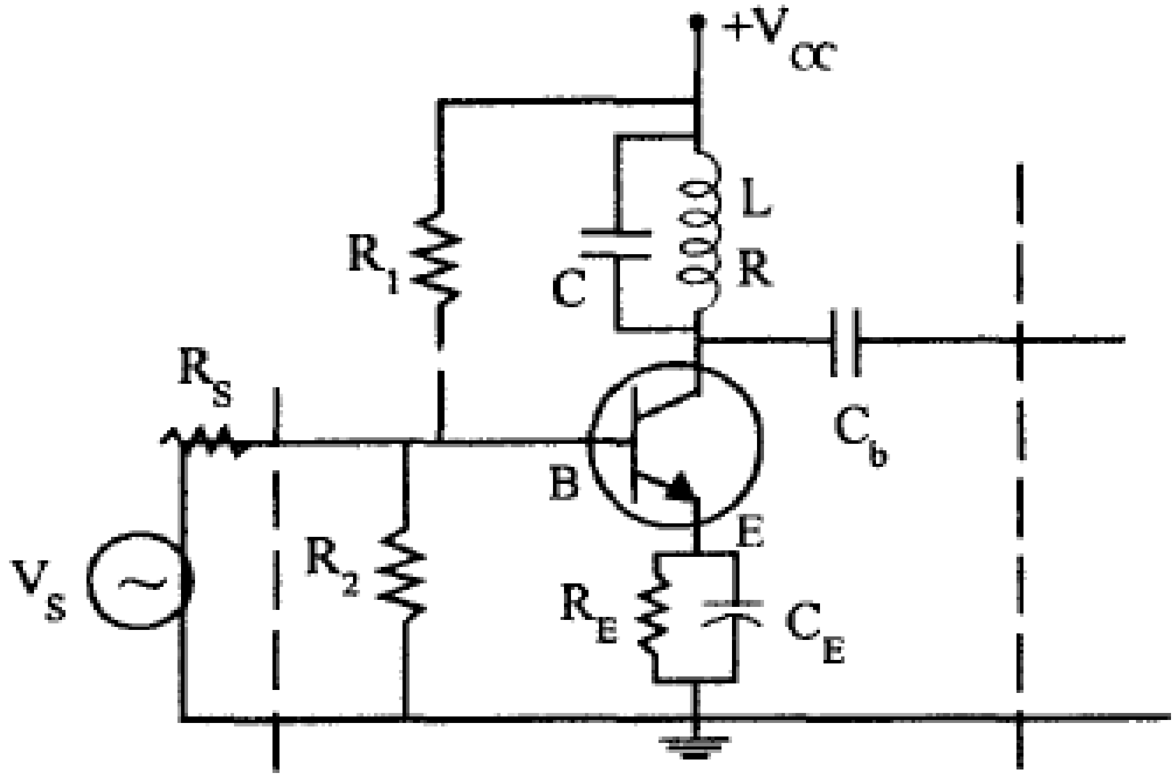
Large Signal

- To amplify large RF signals
- Power output is more
- Operated in class B, class C or class AB modes.
- Pushpull configuration used to further reduce harmonic distortion.

Single Tuned Amplifiers



Single Tuned Amplifier



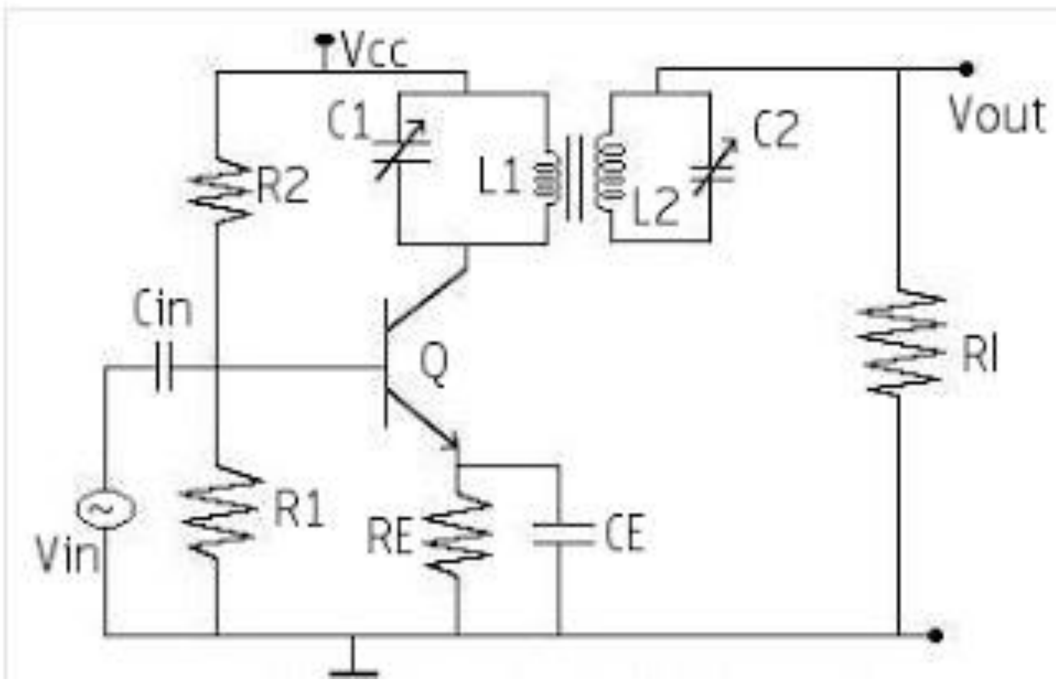
Single Tuned Amplifier

- Single Tuned Amplifier consist of only one Tank Circuit and the amplifing frequency range is Determined by it.
- By giving signal to its input terminal of various Frequency Ranges.
- The Tank Circuit on its collector delivers High Impedence on resonant Frequency.
- Thus the amplified signal is Completely Available on the output Terminal.
- And for input signals other than Resonant Frequency, the tank circuit provides lower imedence, hence most of the signals get attenuated at collector Terminal.

Limitations

- This tuned amplifier are required to be highly selective. But high selectivity required a tuned circuit with a high Q- factor .
- A high Q- factor circuit will give a high A_v but at the same time , it will give much reduced band with because bandwidth is inversely proportional to the Q- factor .
- It means that tuned amplifier with reduce bandwidth may not be able to amplify equally the complete band of signals & result is poor reproduction . This is called potential instability in tuned amplifier.

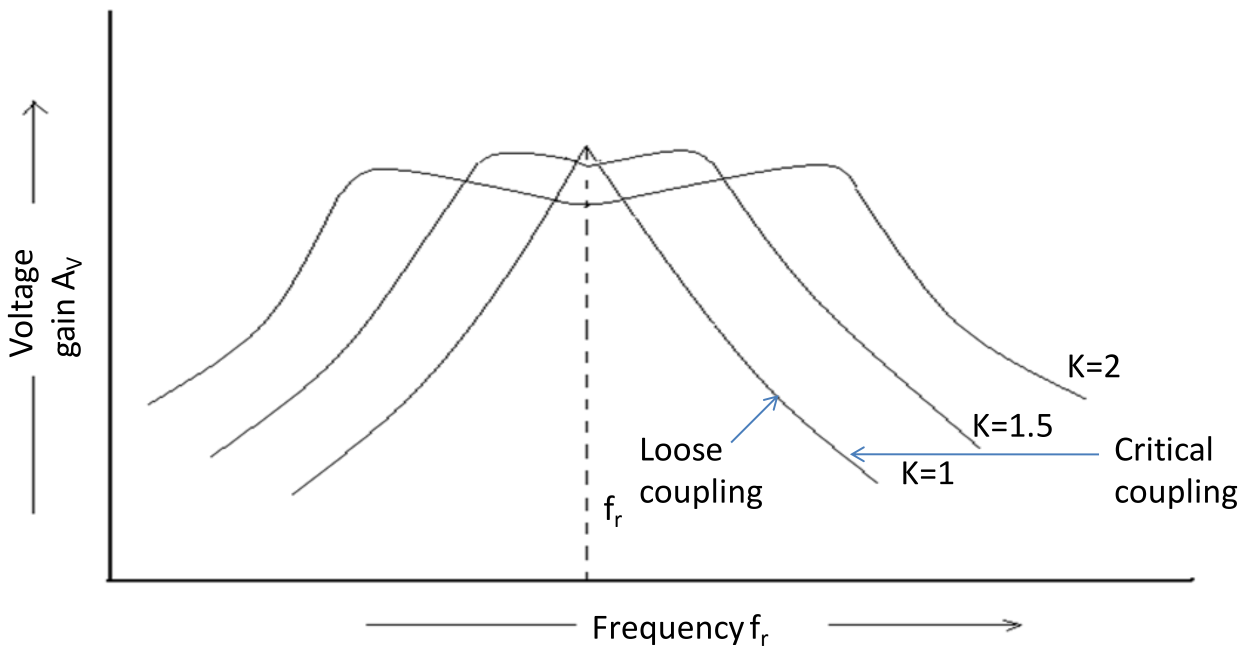
Double tuned amplifier



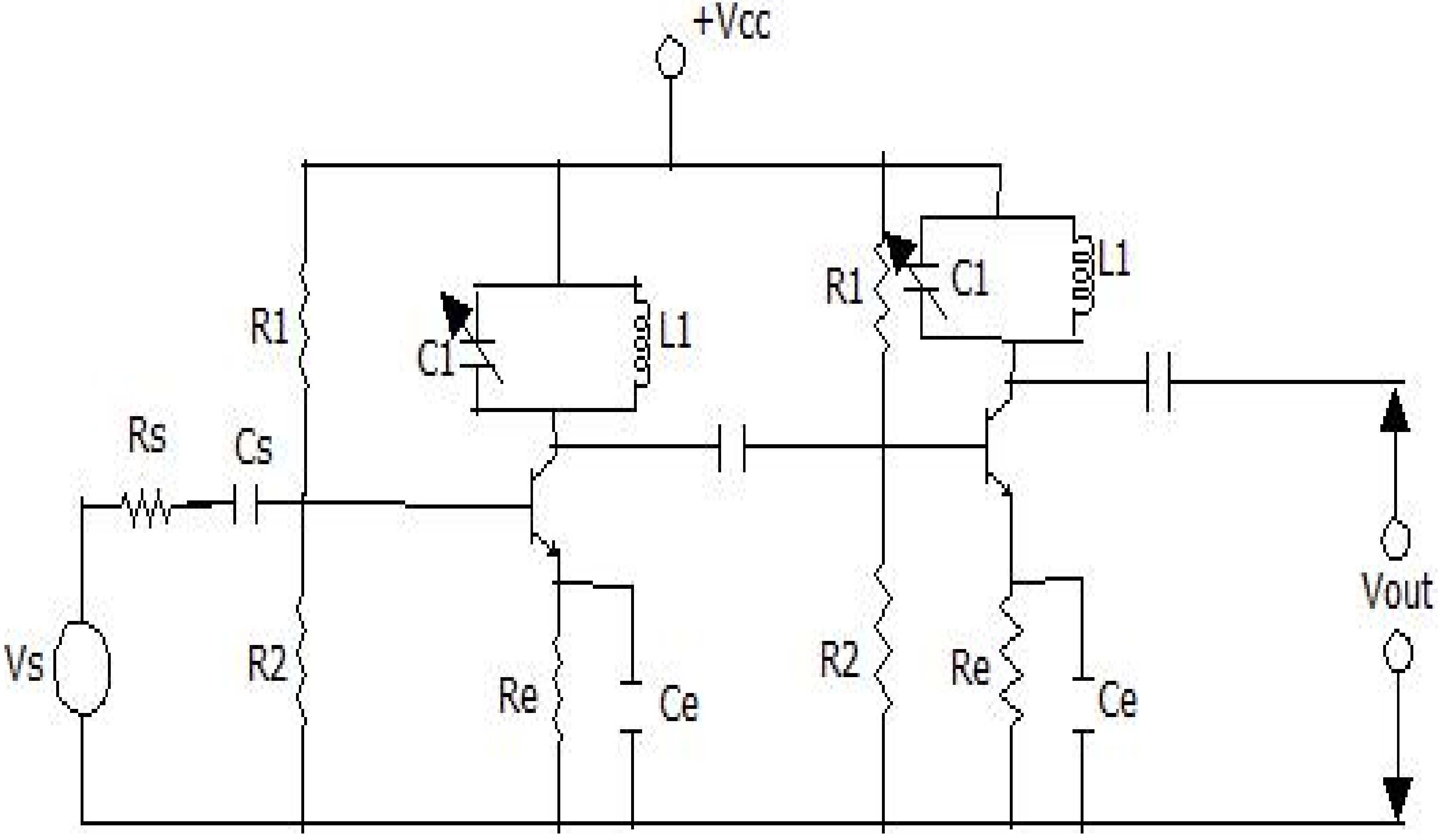
Double tuned amplifier

- Double tuned amplifiers consists of Inductively coupled two tuned circuits. One L1, C1 and the other L2, C2. In the Collector terminals.
  A change in the coupling of the two tuned circuits results in change in the shape of the Frequency response curve.
- By proper adjustment of the coupling between the two coils of the two tuned circuits, the required results(High selectivity, high Voltage gain and required bandwidth) may be obtained.

Resonance curve of Parallel Resonant circuit:



Stagger Tuned Amplifier

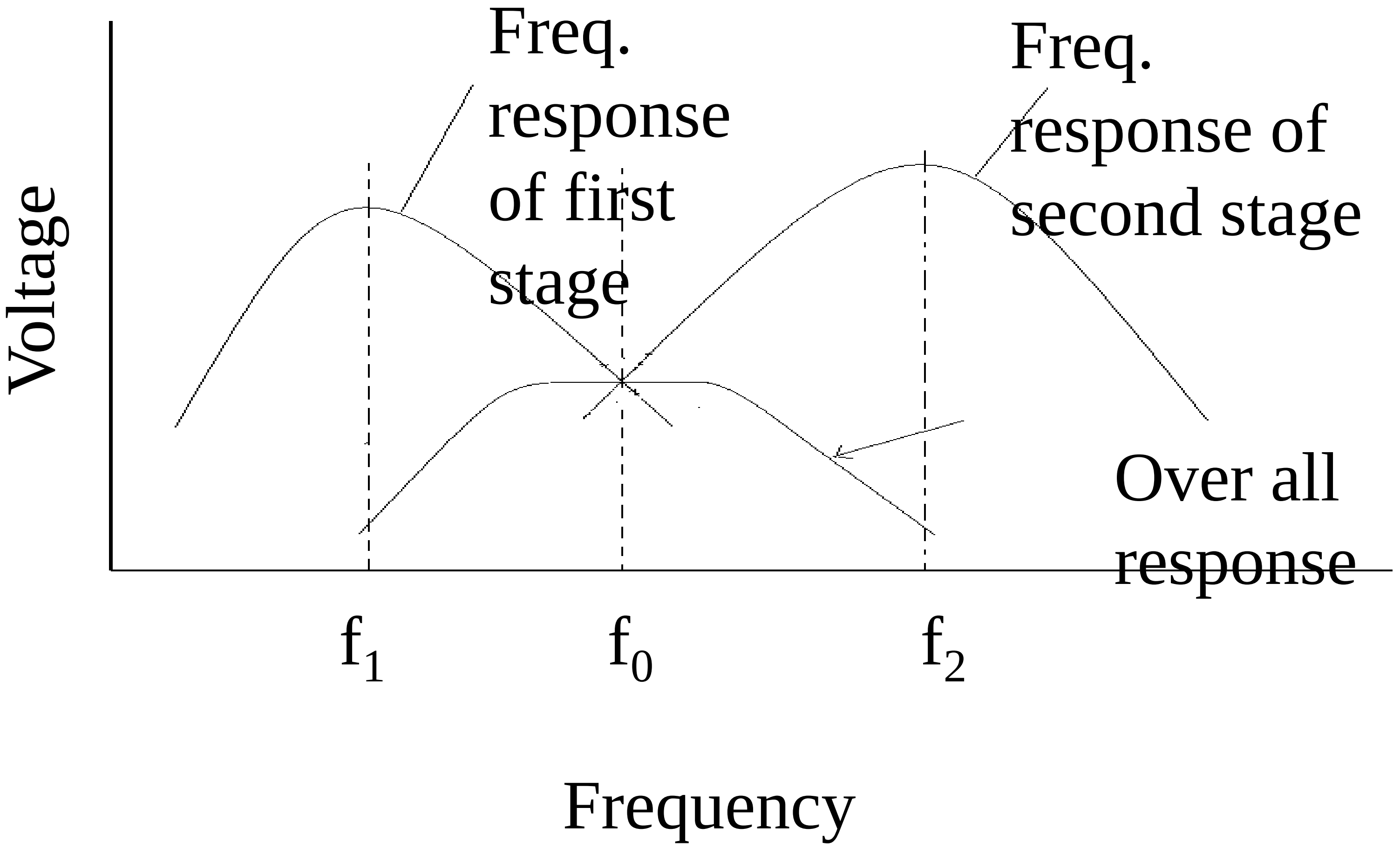


Stagger Tuned Amplifier

- Stagger Tuned Amplifiers are used to improve the overall frequency response of tuned Amplifiers. Stagger tuned Amplifiers are usually designed so that the overall response exhibits maximal flatness around the centre frequency.
- It needs a number of tuned circuit operating in union. The overall frequency response of a Stagger tuned amplifier is obtained by adding the individual response together. Since the resonant Frequencies of different tuned circuits are displaced or staggered, they are referred as Stagger Tuned Amplifier.

- The main advantage of stagger tuned amplifier is increased bandwidth. Its Drawback is Reduced Selectivity and critical tuning of many tank circuits. They are used in RF amplifier stage in Radio Receivers.
- The stagger tuning in this circuit is achieved by resonating the tuned circuits L1 C1, L2 C2 to slightly different Frequencies

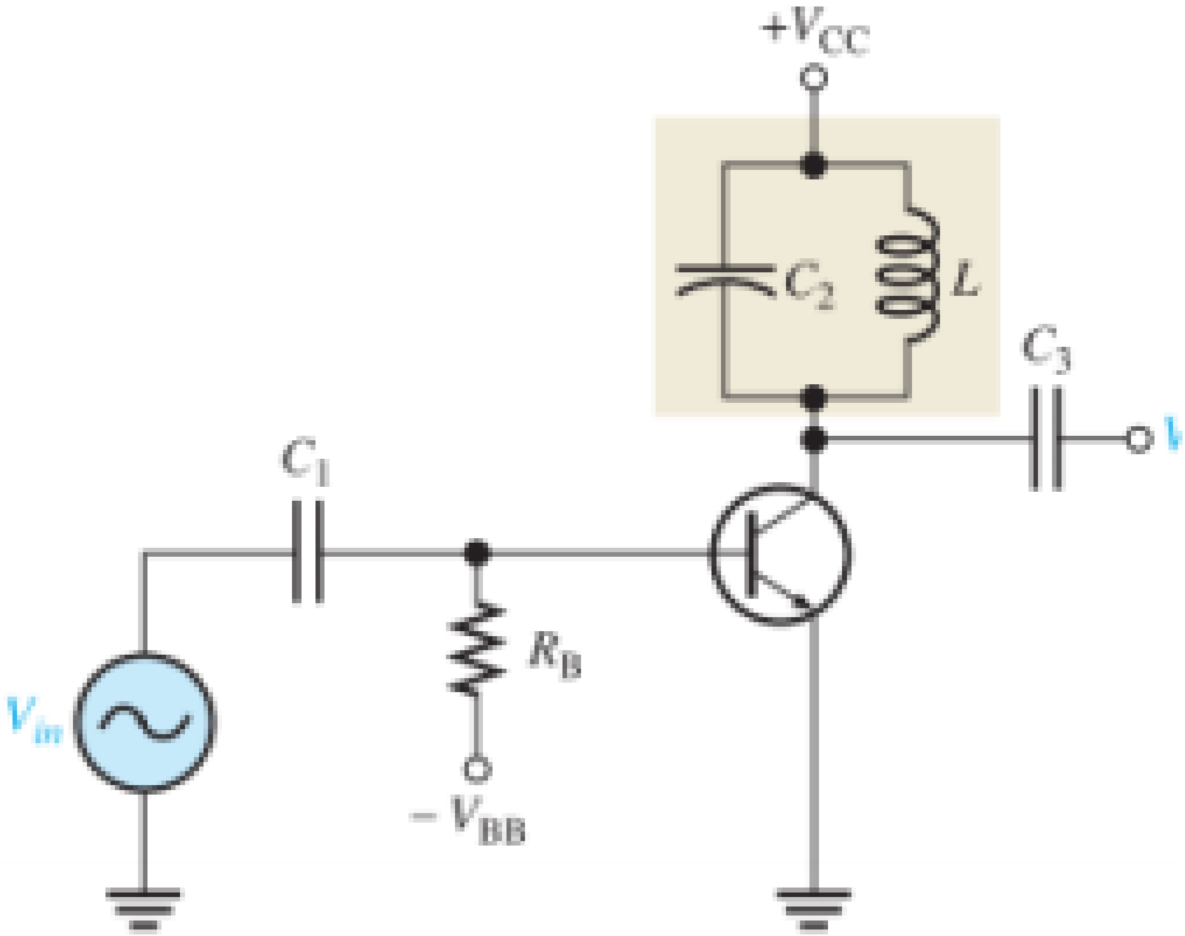
Stagger Tuned Amplifier



Class C Tuned Amplifier

- Class C amplifiers are biased so that conduction occurs for much less than 180 degrees .
- Class C amplifiers are more efficient than either class A or push-pull class B and class AB, which means that more output power can be obtained from class C operation.
- The output amplitude is a nonlinear function of the input, so class C amplifiers are not used for linear amplification.
- They are generally used in radio frequency (RF) applications, including circuits, such as oscillators, that have a constant output amplitude modulators, where a high-frequency signal is controlled by a low-frequency signal.
- Therefore, Class C amplifiers are also called Tuned Amplifiers.

Class C Tuned Amplifier



Class C Tuned Amplifier

- Because the collector voltage (output) is not a replica of the input, the resistively loaded class C amplifier alone is of no value in linear applications.
- It is therefore necessary to use a class C amplifier with a parallel resonant circuit (tank).
- The short pulse of collector current on each cycle of the input initiates and sustains the oscillation of the tank circuit so that an output sinusoidal voltage is produced.
- The tank circuit has high impedance only near the resonant frequency, so the gain is large only at this frequency

Sharpness of the Resonance Curve

- The resonance curve is required to be as sharp as possible in order to provide a high selectivity.
- A sharp resonance curve means that the impedance falls off rapidly as the frequency is varied above and below the resonant frequency.

$$\text{Sharpness of resonance} = \frac{\text{Bandwidth}}{\text{Resonant frequency}} = \frac{BW}{f_o} = \frac{f_2 - f_1}{f_o} = \frac{1}{Q_o}$$

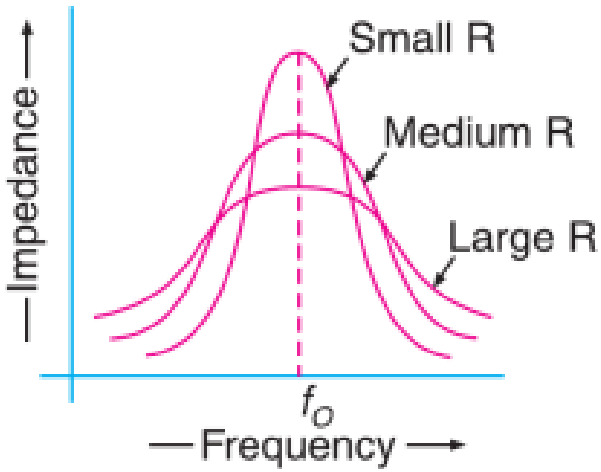
the *Q-factor*, $Q_o = \dfrac{X_L}{R} = \dfrac{\omega_o \cdot L}{R} = \dfrac{2\pi f_o \cdot L}{R}$

L = Value of circuit inductance, and

R = Value of circuit resistance or coil resistance.

$$\text{BW} = \frac{f_o}{Q_o}$$

$$f_o = BW \times Q_o$$



Effect of Coil Resistance (R) on sharpness of the resonant curve

Applications of Tuned Amplifiers

Tuned amplifiers serve the best for two purposes:

a)Selection of desired frequency.

b)Amplifying the signal to a desired level.

Advantages

- It provides high selectivity.
- It has small collector voltage.
- Power loss is also less.
- Signal to noise ratio of O/P is good.
- They are well suited for radio transmitters and receivers

Disadvantages

- They are not suitable to amplify audio frequencies.
- If the band of frequency is increase then design becomes complex.
- Since they use inductors and capacitors as tuning elements, the circuit is bulky and costly.