

UNIT-V

Tuned Amplifiers

Most of the audio amplifiers we have discussed in the earlier chapters will also work at radio frequencies *i.e.* above 50 kHz. However, they suffer from two major drawbacks. First, they become less efficient at radio frequency. Secondly, such amplifiers have mostly resistive loads and consequently their gain is independent of signal frequency over a large bandwidth. In other words, an audio amplifier amplifies a wide band of frequencies equally well and does not permit the selection of a particular desired frequency while rejecting all other frequencies. However, sometimes it is desired that an amplifier should be selective *i.e.* it should select a desired frequency or narrow band of frequencies for amplification. For instance, radio and television transmission are carried on a specific radio frequency assigned to the broadcasting station. The radio receiver is required to pick up and amplify the radio frequency desired while discriminating all others. To achieve this, the simple resistive load is replaced by a parallel tuned circuit whose impedance strongly depends upon frequency. Such a tuned circuit becomes very selective and amplifies very strongly signals of resonant frequency and narrow band on either side. Therefore, the use of tuned circuits in conjunction with a transistor makes possible the selection and efficient amplification of a particular desired radio frequency. Such an amplifier is called a tuned amplifier. In this chapter, we shall focus our attention on transistor tuned amplifiers and their increasing applications in high frequency electronic circuits.

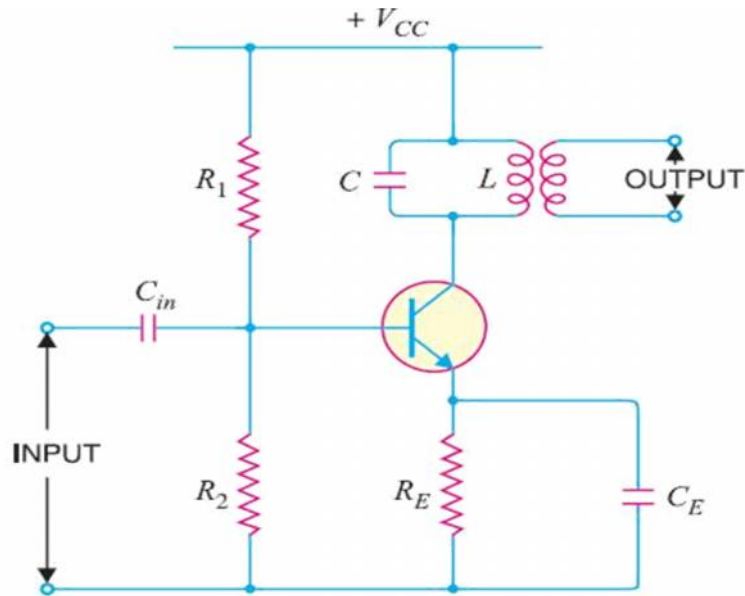
Amplifiers which amplify a specific frequency or narrow band of frequencies are called

tuned amplifiers.

Tuned amplifiers are mostly used for the amplification of high or radio frequencies. It is because radio frequencies are generally single and the tuned circuit permits their selection and efficient amplification.

However, such amplifiers are not suitable for the amplification of audio frequencies as they are mixture of frequencies from 20 Hz to 20 kHz and not single. Tuned amplifiers are widely used in radio and television circuits where they are called upon to handle radio frequencies. Figure shows the circuit of a simple transistor tuned amplifier. Here, instead of load resistor, we have a parallel tuned circuit in the collector. The impedance of this tuned circuit strongly depends upon frequency. It offers a very high impedance at *resonant frequency* and very small impedance at all other frequencies. If the signal has the same frequency as the resonant frequency of

LC circuit, large amplification will result due to high impedance of *LC* circuit at this frequency. When signals of many frequencies are present at the input of tuned amplifier, it will select and strongly amplify the signals of resonant frequency while *rejecting all others. Therefore, such amplifiers are very useful in radio receivers to select the signal from one particular broadcasting station when signals of many other frequencies are present at the receiving aerial.



Distinction between Tuned Amplifiers and other Amplifiers:

We have seen that amplifiers (*e.g.*, voltage amplifier, power amplifier *etc.*) provide the constant gain over a limited band of frequencies *i.e.*, from lower cut-off frequency f_1 to upper cut-off frequency f_2 . Now bandwidth of the amplifier, $BW = f_2 - f_1$. The reader may wonder, then, what distinguishes a tuned amplifier from other amplifiers? The difference is that tuned amplifiers are designed to have specific, usually narrow bandwidth. This point is illustrated in Fig. 15.2. Note that BW_S is the bandwidth of standard frequency response while BWT is the bandwidth of the tuned amplifier. In many applications, the narrower the bandwidth of a tuned amplifier, the better it is.

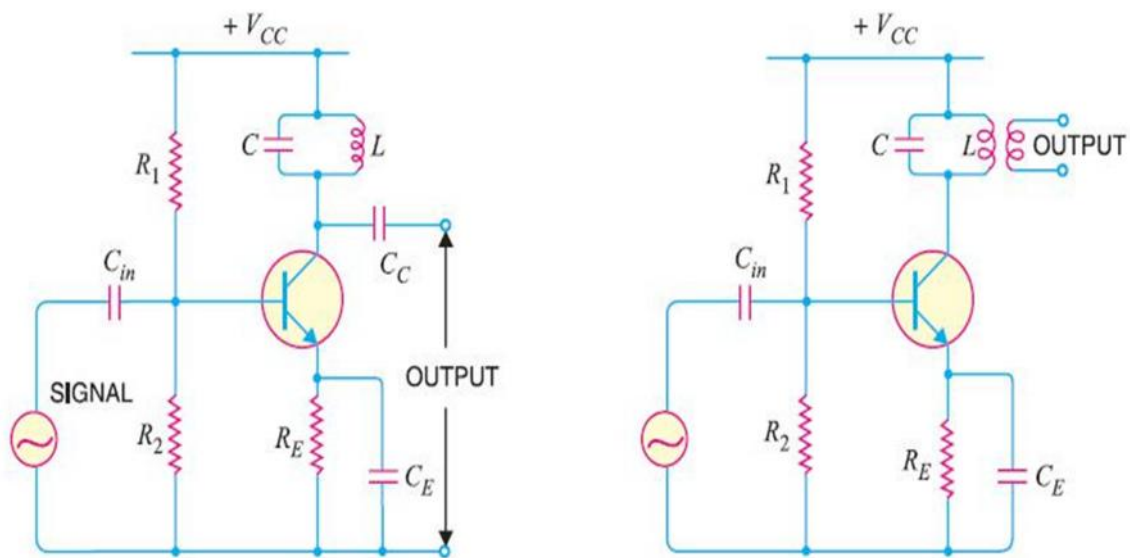


Consider a tuned amplifier that is designed to amplify only those frequencies that are within ± 20 kHz of the central frequency of 1000 kHz (*i.e.*, $f_r = 1000$ kHz). Here $f_1 = 980$ kHz,

$f_r = 1000 \text{ kHz}$, $f_2 = 1020 \text{ kHz}$, $BW = 40 \text{ kHz}$ This means that so long as the input signal is within the range of $980 - 1020 \text{ kHz}$, it will be amplified. If the frequency of input signal goes out of this range, amplification will be drastically reduced.

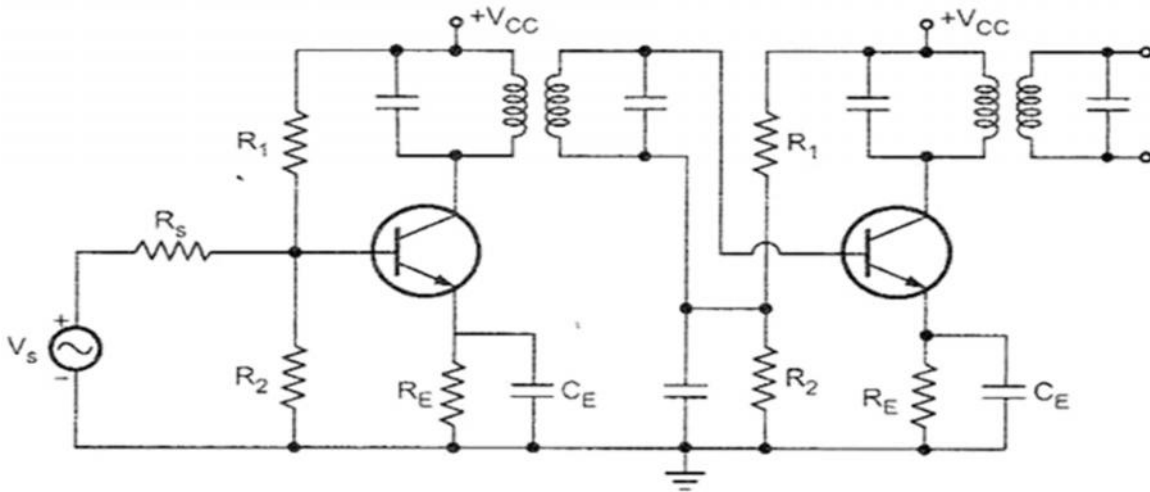
Single Tuned Amplifier

A single tuned amplifier consists of a transistor amplifier containing a parallel tuned circuit as the collector load. The values of capacitance and inductance of the tuned circuit are so selected that its resonant frequency is equal to the frequency to be amplified. The output from a single tuned amplifier can be obtained either (a) by a coupling capacitor C_C as shown in Fig. (i) or (b) by a secondary coil as shown in Fig. (ii).



DOUBLE TUNED AMPLIFIER:

Below figure shows the double tuned RF amplifier in CE configuration. Here, voltage developed across tuned circuit is coupled inductively to another tuned circuit. Both tuned circuits are tuned to the same frequency.



The double tuned circuit can provide a bandwidth of several percent of the resonant frequency and gives steep sides to the response curve.

STAGGER TUNED AMPLIFIER:

The double tuned amplifier gives greater 3dB bandwidth having steeper sides and flat top. But alignment of double tuned amplifier is difficult. To overcome this problem two single tuned cascaded amplifiers having certain bandwidth are taken and their resonant frequencies are so adjusted that they are separated by an amount equal to the bandwidth of each stage. Since resonant frequencies are displaced or staggered, they are known as stagger tuned amplifiers. The advantage of stagger tuned amplifier is to have better flat, wideband characteristics in contrast with very sharp, projective, narrow band characteristics of synchronously tuned circuits (tuned to

same resonant frequencies). Fig. 3.23 shows the relationship of amplification characteristics of individual stages in a staggered pair to the overall amplification of the two stages.

Wide Band amplifiers/Large signal tuned amplifiers:

The output efficiency of an amplifier increases as the operation shifts from class A to class C through class AB and class B. as the output power of a radio transmitter is high and efficiency is prime concern, class B and class C amplifiers are used at the output stages in transmitter. The operation of class B and class C amplifiers are non-linear since the amplifying elements remain cut-off during a part of the input signal cycle. The non-linearity generates harmonics of the single frequency at the output of the amplifier. In the push-pull arrangement where the bandwidth requirement is no limited, these harmonics can be eliminated or reduced. When an narrow bandwidth is desired, a resonant circuit is employed in class B and class C tuned RF power amplifiers to eliminate the harmonics.

Class B tuned amplifier

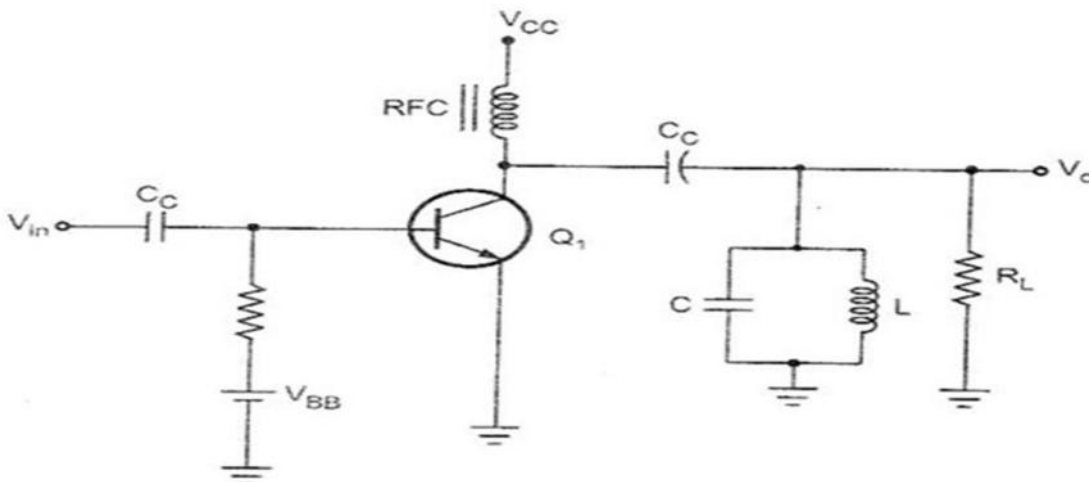


Fig. 3.25 Class B tuned amplifier