Experiment No: 8

Common Emitter BJT Amplifier

Aim:

1. To plot the frequency response of a Common Emitter BJT amplifier.
2. To find the cut off frequencies, Bandwidth and calculate its gain.

Components:

Name	Quantity
Transistor BC547	1
Resistor 74KΩ, 15KΩ, 4.7KΩ, 1KΩ, 2.2KΩ, 8.2K Ω	1,1,1,1,1,1
Capacitor 10µF,100µF, 1 KPF	2, 1,1

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Function Generator	(0-1)MHz	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:

An amplifier is an electronic circuit that can increase the strength of a weak input signal without distorting its shape. The common emitter configuration is widely used as a basic amplifier as it has both voltage and current amplification with 180^0 phase shift.

The factor by which the input signal gets multiplied after passing through the amplifier circuit is called the gain of the amplifier. It is given by the ratio of the output and input signals.

Gain = output signal / input signal

A self bias circuit is used in the amplifier circuit because it provides highest Q-point stability among all the biasing circuits. Resistors R1 and R2 forms a voltage divider across the base of the transistor. The function of this network is to provide necessary bias condition and ensure that emitter-base junction is operating in the proper region.

In order to operate transistor as an amplifier, the biasing is done in such a way that the operating point should be in the active region. For an amplifier the Q-point is placed so that the load line is bisected. Therefore, in practical design it is always set to Vcc/2. This will confirm that the Q-point always swings within the active region. Output is produced without any clipping or distortion for the maximum input signal. If not reduce the input signal magnitude.

The Bypass Capacitor:

The emitter resistor is required to obtain the DC quiescent stability. However the inclusion of it in the circuit causes a decrease in amplification. In order to avoid such a condition, it is bypassed by capacitor so that it acts as a short circuit for AC and contributes stability for DC quiescent condition. Hence capacitor is connected in parallel with emitter resistance which increases the A.C gain.

The Coupling capacitor:

An amplifier amplifies the given AC signal. In order to have noiseless transmission of a signal (without DC), it is necessary to block DC i.e. the direct current should not enter the amplifier or load. This is usually accomplished by inserting a coupling capacitor between two stages.

Frequency response :

The plot of gain versus frequency is called as frequency response. The coupling and bypass capacitors causes the gain to fall at low frequency region and internal parasitic capacitance and shunt capacitor causes the gain to fall at high frequency region. In the mid frequency range large capacitors are effectively short circuits and the stray capacitors are open circuits, so that no capacitance appear in the mid frequency range. Hence the mid band frequency gain is maximum. Hence we get a Band Pass frequency response

Characteristics of CE Amplifier:

- Large current gain.
- Large voltage gain.
- Large power gain.
- Current and voltage phase shift of 180°.
- Moderate output resistance.

Circuit Diagram:

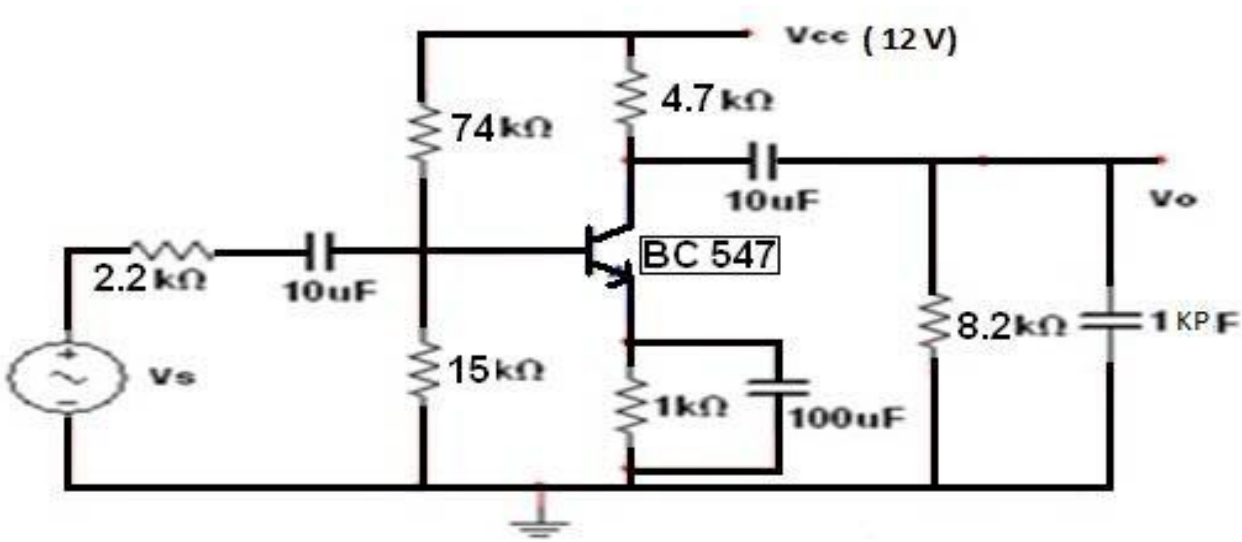

Fig. 1: CE BJT Amplifier

Procedure:

1. Connect the circuit as shown in fig.1, Set source voltage as 50mV P-P at 1 KHz frequency using the function generator.
2. Keeping the input voltage as constant, vary the frequency from 50 Hz to 1 MHz in regular steps and note down the corresponding output P-P voltage.
3. Plot the graph for gain in (dB) verses Frequency on a semi log graph sheet.
4. Calculate the bandwidth from the graph.

Observations:

Frequency	Vs (Volts)	Vo(Volts)	Gain = Vo/Vs	Gain(dB) = 20 log(Vo/Vs)

Graph:

In the usual application, mid band frequency range is defined as those frequencies at which the response has fallen to 3dB below the maximum gain (|A| max). These are shown as f_L, f_H and are called as the 3dB frequencies or simply the lower and higher cut off frequencies respectively. The difference between the higher cut off and lower cut off frequency is referred to as the bandwidth (f_H - f_L).

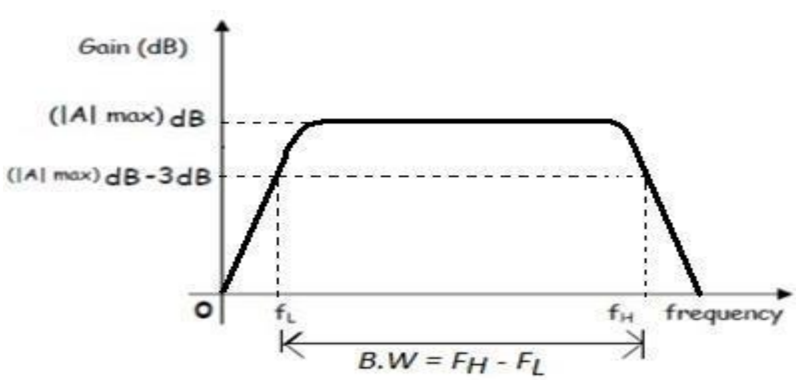

Fig. 2: Frequency Response Curve of RC coupled BJT CE Amplifier

Calculations from Graph:

Precautions:

1. While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.
2. Connect signal generator in correct polarities as shown in the circuit diagram.
3. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
4. Make sure while selecting the emitter, base and collector terminals of the transistor.

Results:

1. The BJT CE amplifier is studied
2. The frequency response curve of the BJT CE amplifier is plotted.
3. Lower cutoff frequency, f_L = …………….

   Higher cutoff frequency, f_H = ……………

   Bandwidth = $f_H - f_L$ = ……………