Experiment #1 Common Emitter amplifier

Objective
To study, analyze and implement the common Emitter amplifier and observe their results.

Equipment
Function generator with probes
DMM
Dc supply
oscilloscope
Capacitor (10uF 100uF)
Transistor 2N2222
Resistor

Theory

Amplification is the process of increasing the strength of signal. Amplifier are the devices that provide amplification without appreciably altering the original signal. BJTs are frequently used as amplifier. It is a current amplifier having three terminals. Base Emitter and collector. The small current into base controls the large current flows collector to Emitter this makes it possible to obtain a large amplification of voltages by taking output from arrestor in parallel with collector.

Common Emitter configuration

In this arrangement the output taken collector to Emitter and input is applied between base and emitter. Common Emitter amplifier with large voltage divider circuit consist of three capacitor one at input one at output and one act as the coupling capacitor with emitter resistor as shown in Figure 1.1. Input signal is applied at base and output is given at collector terminal.

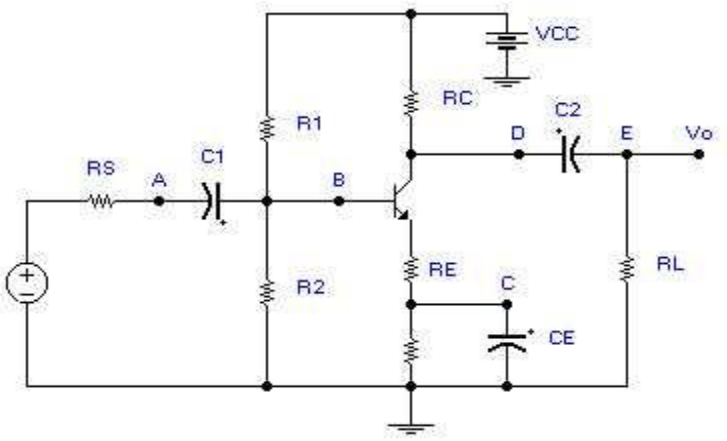

Figure 1.1: Common Emitter Amplifier

Operation of Common Emitter Amplifier

First of all transistor is properly biased. The purpose of biasing is to obtain certain DC collector current and collector voltages. These values are called operating points. The most common biasing circuit is voltage divider. In this method two resistances R1 and R2 are connected across supply voltage Vcc.

The voltage drops across R2 forward biased emitter junction this cause base current and hence collector current flows in zero signal condition. Resistance Re provide stabilization.

DC analysis

For amplification, a transistor must be in active region. For common Emitter configuration we have

1. Emitter base junction must be in forward biased
2. Collector base junction must be in reversed biased

DC analysis is done to find out DC parameters like Vc, V_{CE}, V_B, V_{BE}, I_C, I_B and I_E. It is also used to find the Q point of transistor.

For DC analysis the coupling capacitor and bypass capacitor are open circuited.

To find DC parameters,

$$V_B = \left(\frac{R_2}{R_1+R_2}\right) V_{cc} \qquad (1.1)$$

$$V_E = V_B - V_{BE} \qquad (1.2)$$

$$V_c = V_{CC} - I_C R_C \qquad (1.3)$$

$$I_E = \frac{V_E}{R_E} \qquad (1.4)$$

$$I_C = I_E \qquad (1.5)$$

$$V_{CE} = V_C - V_E \qquad (1.6)$$

AC analysis

To analyze the AC values first draw AC equivalent circuit.

To draw AC equivalent circuit, follow these steps.

1. Capacitor C1 C2 C3 are replaced by effective short circuit

2. The DC source is replaced by a ground

In AC analysis we measure Z_{in}, Z_O output voltages and voltage gain.

Z_{in} (Input Impedance)

Resistance connected to input.

$$Z_{in} = R_{in}(tot) = R_1 \parallel R_2 \parallel R_{in(\text{base})} \quad (1.7)$$

Where,

$$R_{in}(base) = \beta r_e \quad (1.8)$$

Zo (Output Impedance)

Resistance connected at output. It can be R_c or $R_c \parallel R_L$

$$Z_{out} = R_{out} = R_C \parallel r_c \quad (1.9)$$

$$Z_{out} = R_C \parallel R_L \text{ if } R_L \text{ is connected}$$

Voltage gain

$$A_v = {}^{Vc}/_{Vb} = {}^{Rc}/_{re} \quad (1.10)$$

Output voltages

$$V_c = A_v V_b \quad (1.11)$$

Circuit Diagram

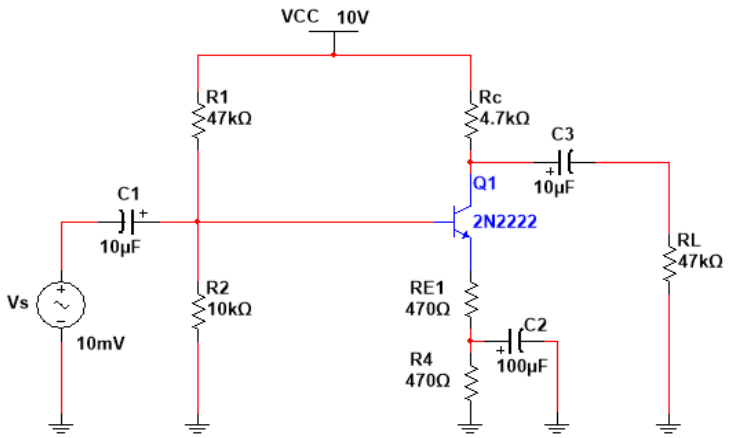

Figure 1.2: Circuit Diagram of Common Emitter Amplifier

Procedure

1. Collect the components required for the experiment.
2. Insert 2N2222 transistor in the breadboard and construct circuit according to given circuit diagram.
3. Calculate DC values by DC analysis of transistor.
4. Measure $V_{E,}$ $V_{B,}$ $I_{E,}$ and V_C.
5. Record the DC values in given table.
6. Apply AC signal and analyzed AC values.
7. In AC analysis, measure the input voltages output voltages and calculate voltage gain
8. Compare the Calculated and measured values

Observations

Sr No.	Parameter	Theoretical Values	Practical Values
1	V_E		
2	V_C		
3	V_B		
4	I_C		
5	I_B		
6	I_E		
7	V_O		
8	A_V		

Lab Tasks

1. Find voltage gain when only one emitter resistor is connected.
2. Find voltage gain when no load resistor is connected

Conclusion