EXPERIMENT-2

TITLE-DESIGN AND SIMULATION OF COMMON EMITTER AMPLIFIER WITH STABLE OPERATING POINT.

OBJECTIVE-

- Know how to stabilize the operating point of a CE amplifier.
- Constructing a CE amplifier topology and bias the transistor for proper analog operation.
- Observe and analyze “small signal” frequency Response of the amplifier.
- Know the practical values of gain and band width of a simple voltage amplifier

- ## THEORY:

  The most common amplifier configuration for an NPN transistor is that of common emitter amplifier circuit. Biasing is very important in amplifier design as established the correct operating point of transistor amplifier ready to receive signals, thereby reducing any distortion to output signal. A BJT can be biased through two methods fixed -bias and self -bias.

FOR FIXED-BIAS

This type of transistor biasing arrangement is also beta dependent biasing as the steady-state condition of operation is a function of the transistor beta value, so the biasing point will vary over a wide range for transistors of the same type as the characteristics of the transistors will not be exactly the same.

FOR SELF-BIAS

Here the common emitter transistor configuration is biased using a voltage divider network to increase stability. The voltage divider is the most widely used transistor biasing method.

PART-A

AIM-Compare bias point stability of CE amplifier with Fixed-bias and that with Self-bias.

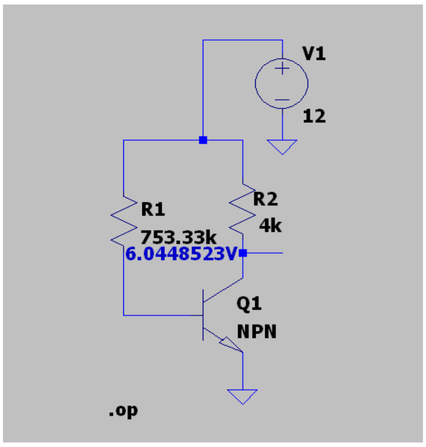
COMPONENTS:

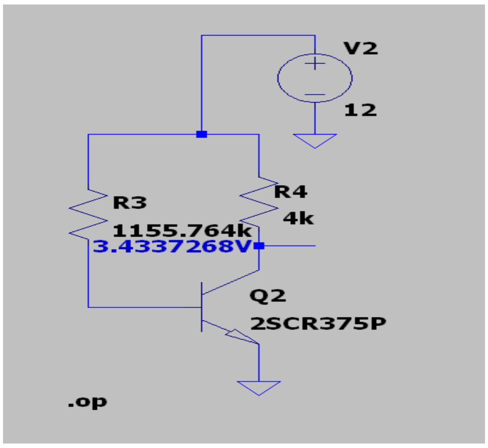
Components	Quantity	Specifications
NPN BJT	2	default
Resistor	6	753.33k(1) 4k (2) 5k (1) 4.7k(1) 3.3k(1)

Voltage source	2	12V
Connecting wire	-	-

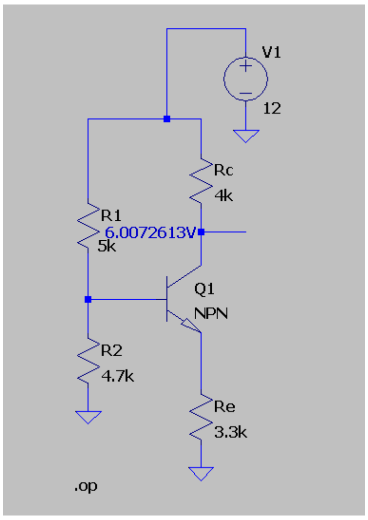
CIRCUIT DIAGRAMS MADE IN LTSPICE

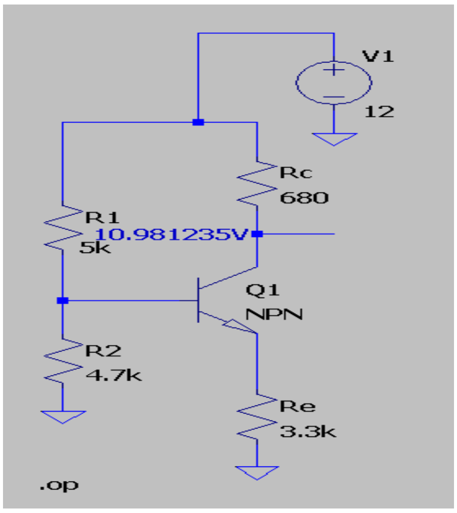
FOR FIXED-BIAS





FOR SELF-BIAS





OBSERVATION:

We are trying to observe the variation in operating points for same value of V_{ce} and I_c

FOR FIXED-BIAS

Beta	Operating point(v)	I_c
100	6.0448V	1.488mA
153.42	3.433V	1.891mA

FOR SELF-BIAS

Beta	Operating point	I_c
100	10.9812V	1.498mA
153.42	10.9713V	1.512mA

In the fixed biasing, we can see that there is drastic change in operating point for similar range of I_c for different transistor.

But ,change is isn't as much drastic in case of self biasing even there is a drastic change in value of beta.

The operating point can be observed to be almost independent of the values of beta. Thus circuit would be more stable.

Also only one DC supply would be enough to bias both common and emitter terminal.

These merits make self biasing to be widely used in biasing as compared to fixed biasing.

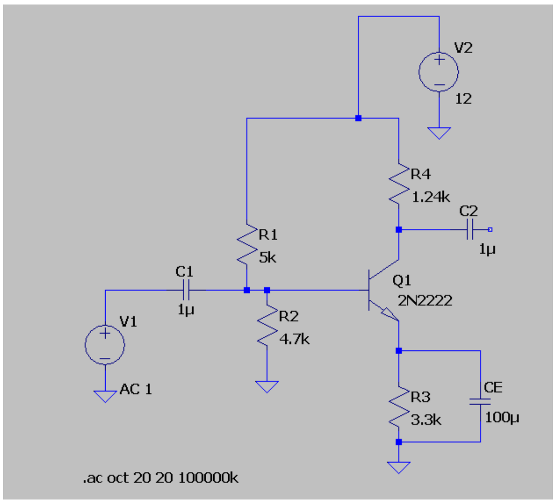
PART-B

AIM-Design and simulation of a CE amplifier with Self-bias

COMPONENTS:

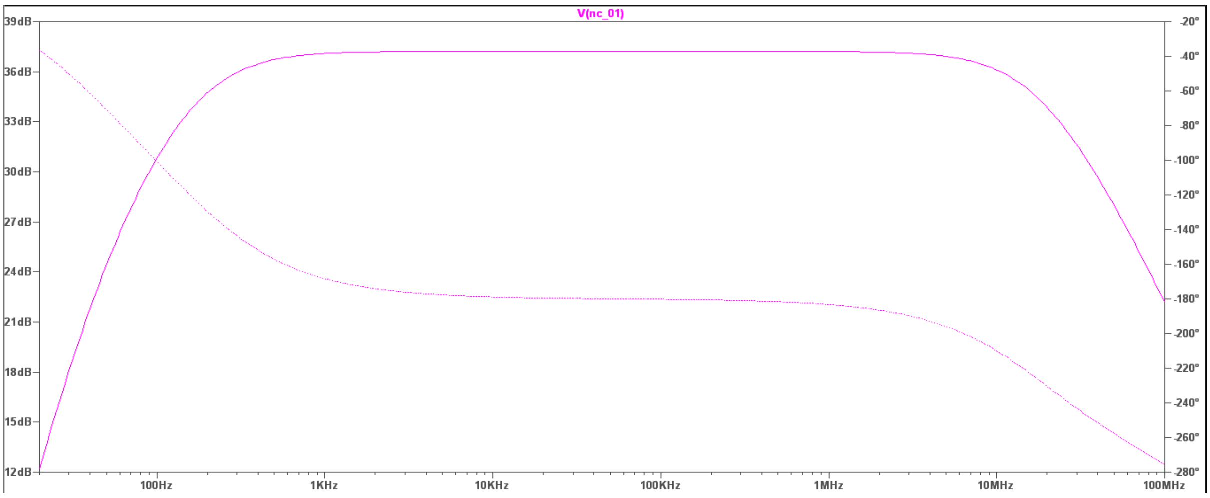
Components	Quantity	Specification
2N2222 BJT	1	default
Resistors	4	5k (1) 4.7k(1) 1.24k(1) 3.3k(1)
Capacitor	3	1micro (2) 100micro (1)
Voltage source	1	12V
Input voltage	1	-
Connecting wires	-	-

CIRCUIT DIGRAM MADE IN LTSPICE



We took transistor 2N2222 to get complete bode plot corresponding to the values taken.

GRAPH:



OBSERVATION:

- From graph, we can observe the phase response is represented in dotted line and gain in bold line.
- The peak amplification is 34.2249dB.
- The f_{-3dB} is 177.86Hz and 18.3611MHz and corresponding phase angles -124.9221(degrees) and -227.760(degrees)
  At start and end cut-off respectively.
- The operating point 4.9515V(10.0815-5.1300).

THEORETICAL CALCULATIONS:

- From the small signal model,
  We know
  $$g_m=I_c/V_T (I_c=1.547mA, V_T=26mV)$$
  which gives g_m=0.0595mho.
- R_c=1.24Kohm.
- We know,
  $$gain=V_O/V_{in}=(-g_m*R_c)$$
  we get,
  $$gain= -73.78V/V \text{ or } 37.358dB.$$

CONCLUSION:

The theoretical value is almost equal to the experimental value in Bode plot.