NAME: HRISHIKESH G KULKARNI **DATE: 11/04/2022**

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BRANCH: BTECH - CSE AND SPEC IN AI/ML – VITCHENNAI

BECE101P_SLOT-L5+L6_EXPERIMENT – 08

FACULTY: PROF. SASITHRADEVI MA'AM

Transient, Frequency Response and Bandwidth of Single Stage BJT Amplifier

AIM: To study and to construct a single stage BJT amplifier circuit by using LT-Spice and to verify its Transient and Frequency response curve. Also, to calculate the bandwidth of the amplifier.

SOFTWARE REQUIRED: LT-Spice

Apparatus required: NPN Transistor-1, Resistor-6, Voltage source-2, Capacitor-3, wires and grounding.

THEORY:

NPN Transistor

The NPN transistor consists of two n-type semiconductors that sandwich a p-type semiconductor. Here, electrons are the majority charge carriers, while holes are the minority charge carriers.

Single Stage Transistor Amplifier

When in an amplifier circuit only one transistor is used for amplifying a weak signal, the circuit is known as single stage amplifier.

However, a practical amplifier consists of a number of single stage amplifiers and hence a complex circuit. Therefore, such a complex circuit can be conveniently split into several single stages and can be effectively analysed.

When a weak a.c. signal is applied to the base of the transistor, a small base current starts flowing in the input circuit.

Due to transistor action, a much larger (β times the base current) a.c. current flows through the the load Resistor in the output circuit.

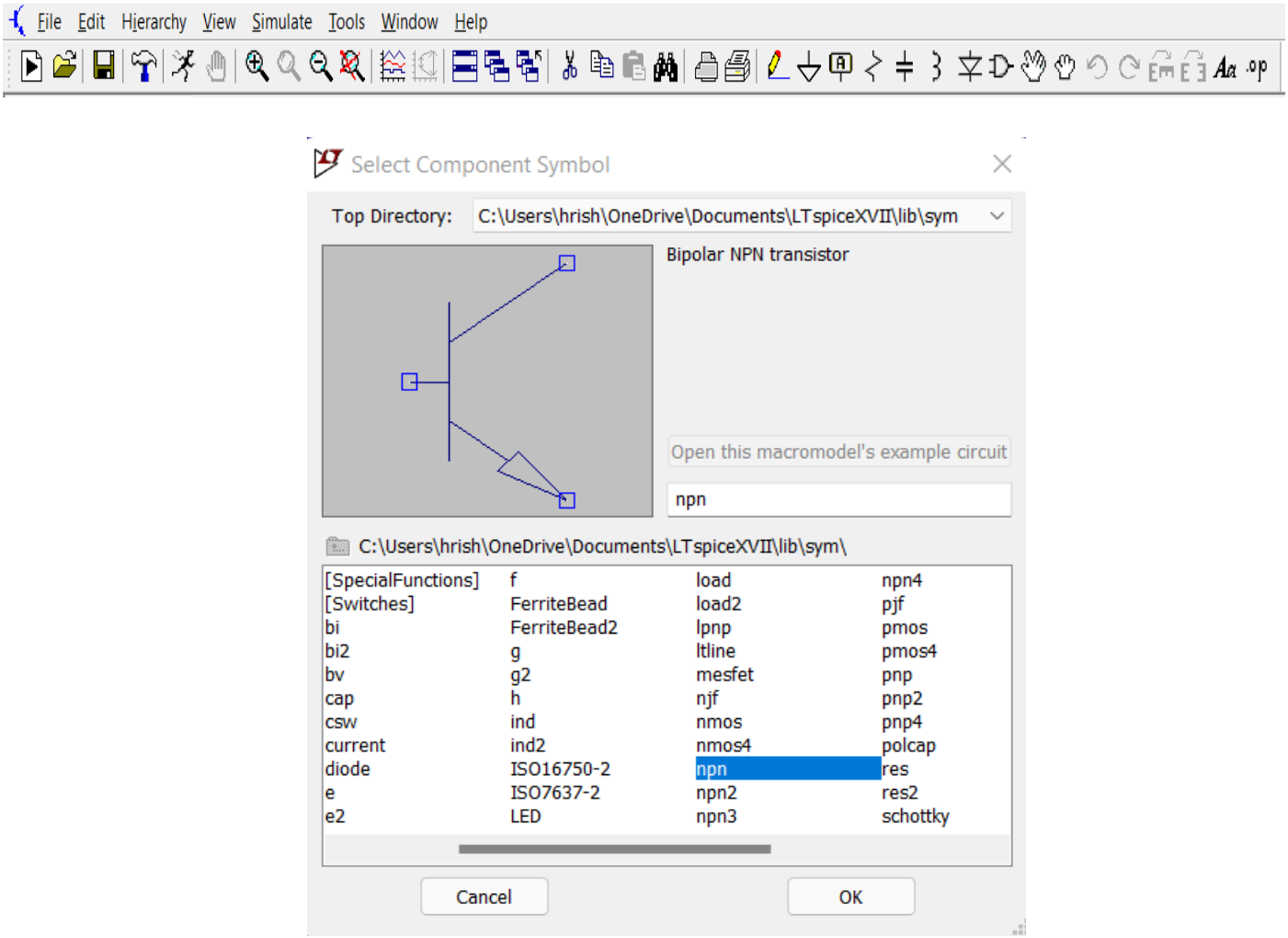
Since the value of load resistance is very high, a large voltage will drop across it.

Thus, a weak signal applied in the base circuit appears in amplified form in the collector circuit. In this way the transistor acts as an amplifier.

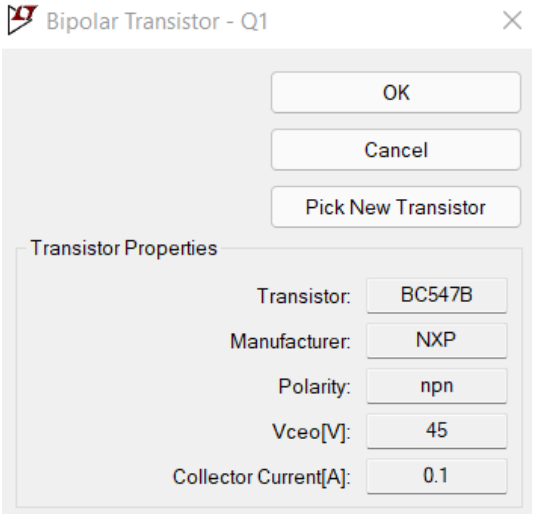
PROCEDURE

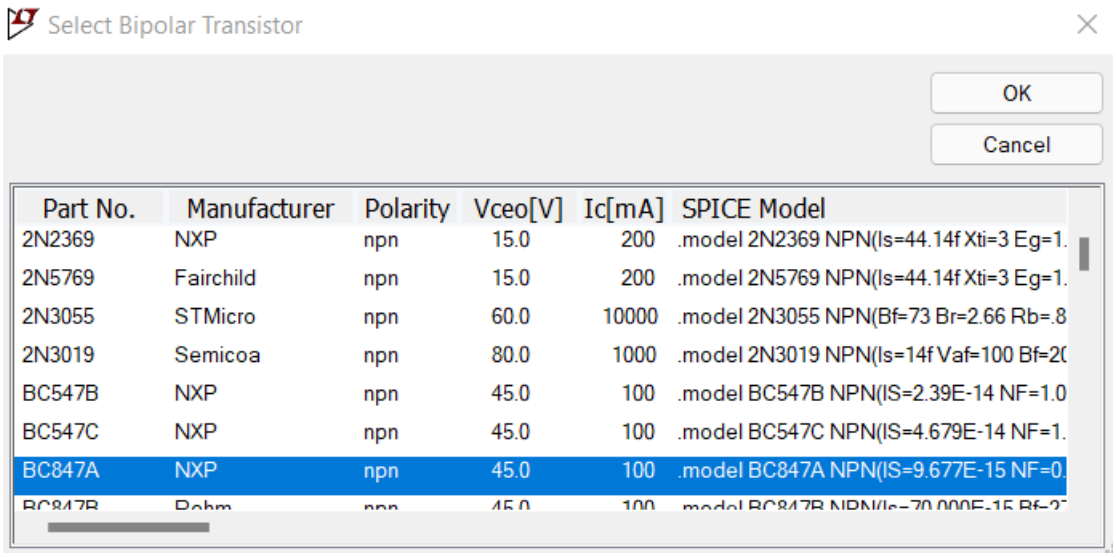
TRANSIENT RESPONSE OF SINGLE STAGE BJT AMPLIFIER

1. Click the component library symbol from the toolbar and select the NPN Transistor from the component library.

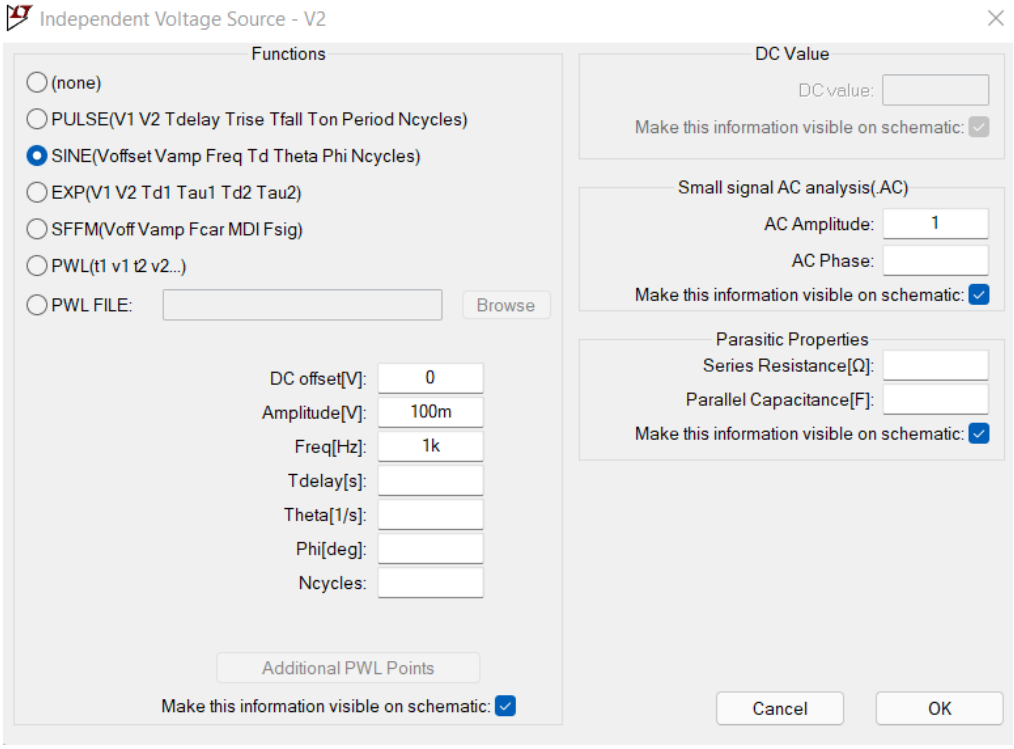


2. Now, right the NPN Transistor and click ‘pick new transistor’ choose the one as shown below.

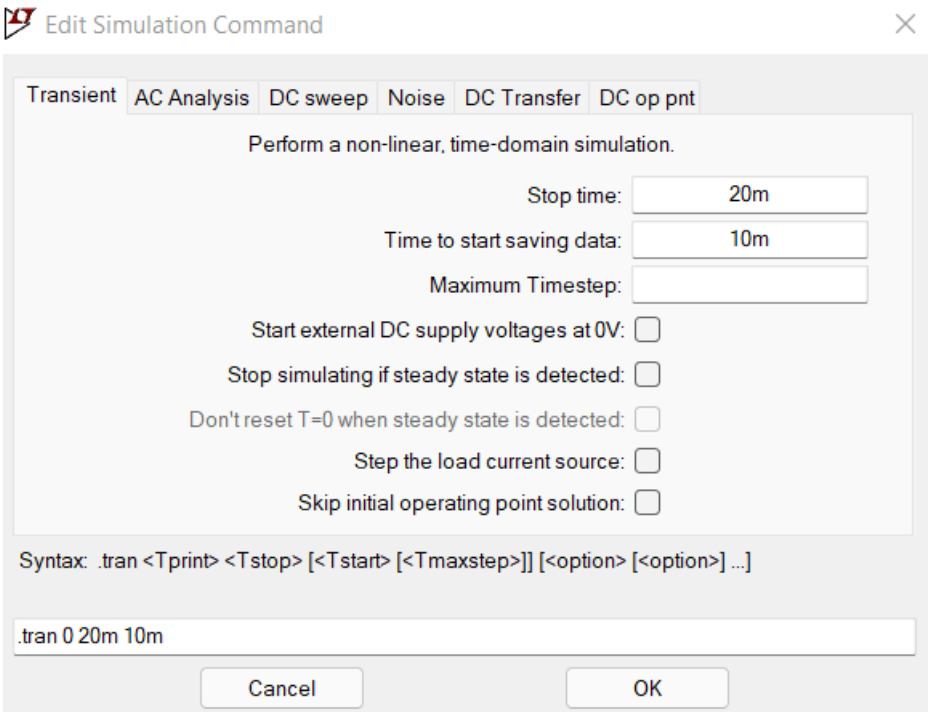




3. Now, draw the circuit by adding 2 voltage sources, 6 resistors and 3 capacitors, wires and also all the grounding connections. Draw the circuit exactly as in the circuit diagram shown later in this document.
4. Now gives values → R1(100K ohms), R2(1.5K ohms), R3(5.6K ohms), R4(33K ohms), R5(470K ohms) and R6(22K ohms) for resistors. V1(20 V) and for V2 giving a a.c. sine source whose settings are shown below. C1(12µF), C2(12µF) and C3(39µF) for capacitors.



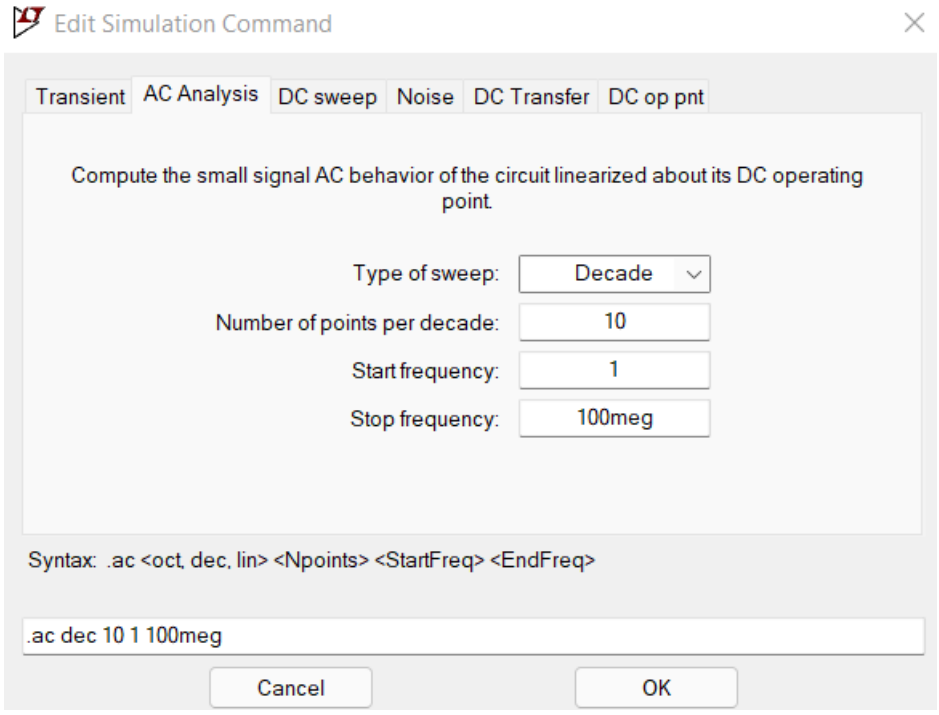
5. Now, under simulate section click on edit simulation command and click on Transient for analysis and give the values as shown below in the image.



6. Now under simulation click on the 'Run' button and then on the graph right click to add traces V(n003) and V(n004). Now we can see the Transient response of the single stage BJT Amplifier.

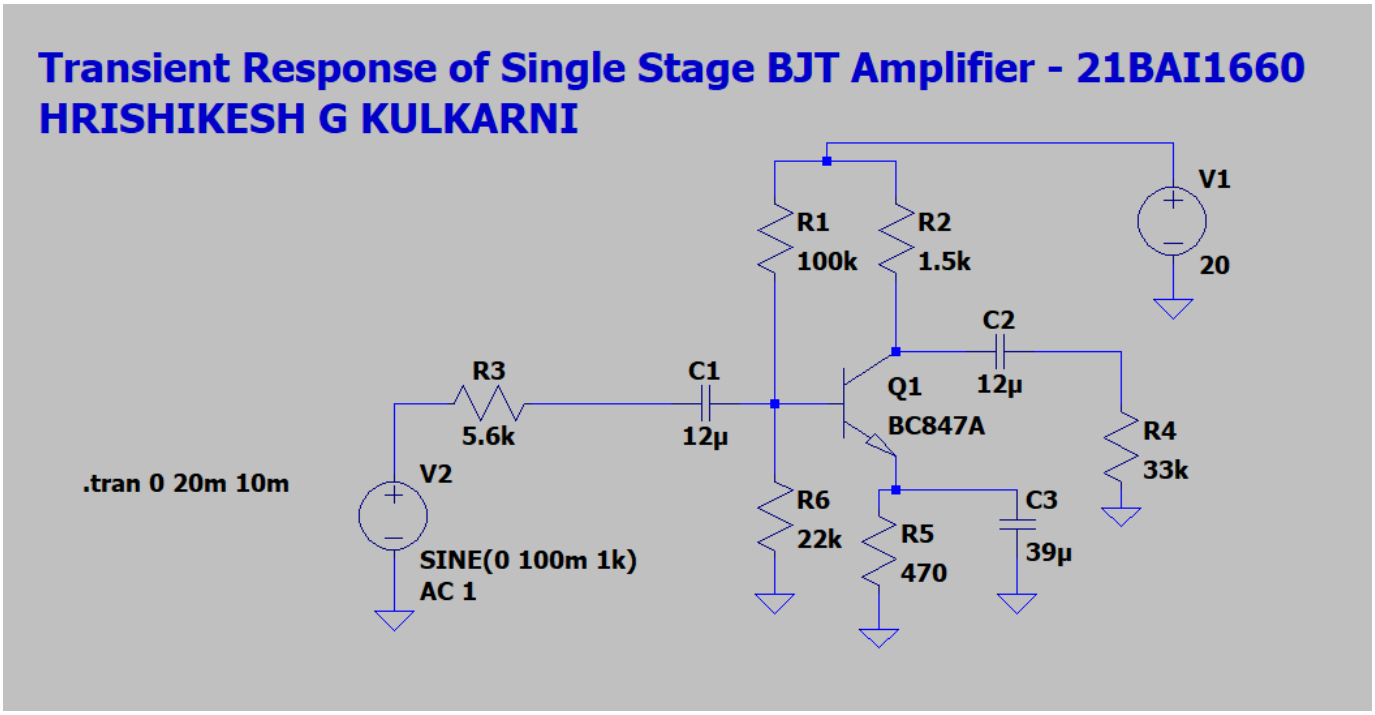
FREQUENCY RESPONSE OF SINGLE STAGE BJT AMPLIFIER

1. We shall be using the same circuit as the one we used for the transient response but we will be making changes to the simulation.
2. Now under the simulation tab go under the edit simulation and click on the AC Analysis tab inside this and then give the settings as shown below.



3. Now click on Ok and under simulation section click on the 'Run' button.
4. When the graph panel appears right click and add traces V(n003) then a plotted graph appears.
5. On the top left click on V(n003) and point(cursor) with frequency(x-axis) 9.939 KHz and Magnitude or Decibels(y-axis) 30.7987db appears on the graph.
6. Now, we must move this point(cursor) where the Magnitude or Decibels(y-axis) value becomes 30.798db – 3db = 27.798db value on the left side of the graph.
7. Next, we must add a second point (cursor) and move the Magnitude or decibels(y-axis) value becomes 30.798db – 3db = 27.798db value on the right side of the graph.
8. These both points have the same y-value (decibels or magnitude) and different x-values.
9. **For cursor-1 x-value is 141.70802KHz and for cursor-2 x-value is 507.20004KHz and both have same y-value 27.82db.**
10. Now using add text add as lower frequency = 141.5206KHz and higher frequency = 509.9657KHz. Also add another text as 3db line and place on the line which is y=27.8db, this is common y-value line for both cursors.
11. Now, find the bandwidth frequency by subtracting the higher frequency and the lower frequency. **Bandwidth frequency = 507.20004KHz – 141.70802KHz = 365.49202KHz**
12. **Finally add another text→ Bandwidth frequency = 507.20004KHz – 141.70802KHz = 365.49202KHz.**

CIRCUIT DIAGRAMS



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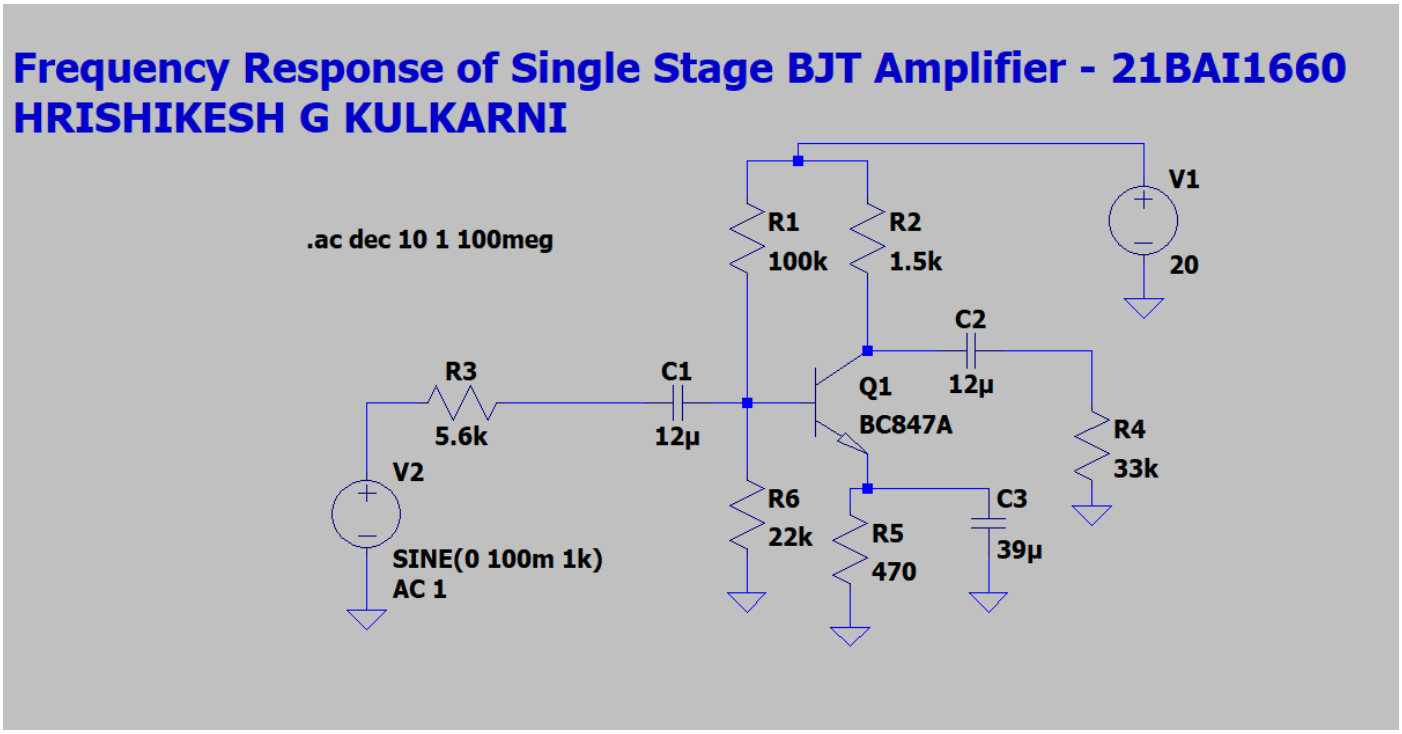
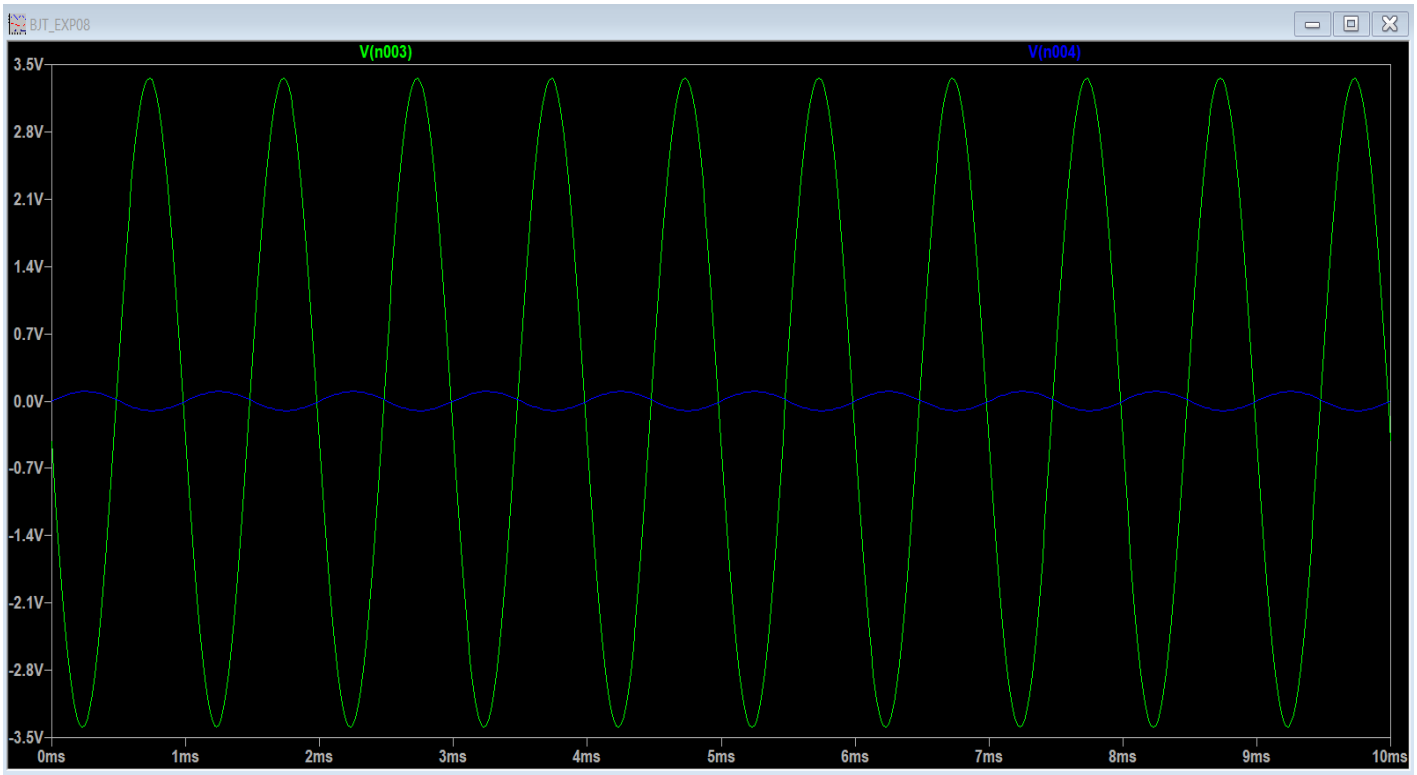
V



OUTPUT

Transient Response of Single Stage BJT Amplifier



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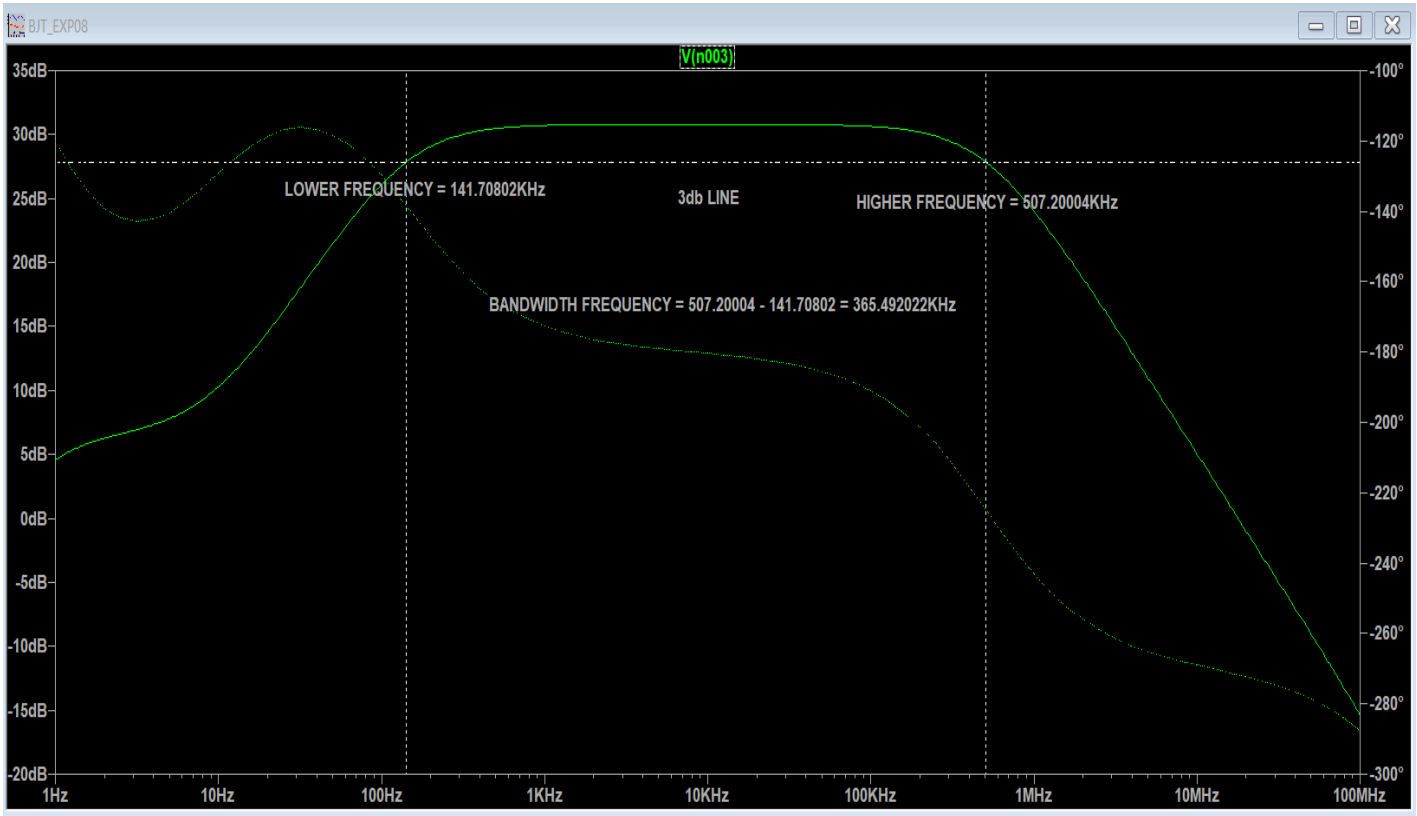
V

Frequency Response of Single Stage BJT Amplifier



RESULT AND INFERENCE

Bandwidth = Upper cut-off frequency (U.F.) – Lower cut-off frequency (L.F.)

From the graph,

U.F. = 507.20004KHz

L.F. = 141.70802KHz

- **Bandwidth Frequency = 507.20004KHz - 141.70802KHz = 365.49202KHz**

From the simulation, we have the understood, studied and observed the transient and the frequency responses of the Single Stage BJT Amplifier.

=====THE END=====