DEVICES AND CIRCUITS LAB REPORT – 3

EXPERIMENT NAME : BJT Common Emitter Amplifier Characteristics

ROLL NUMBERS : 200020010 , 200020051

Ng Spice Code :

```
*bjt
vin 1 0 12
R1 1 2 36k
R2 2 0 10k
Rc 1 6 5k
vdc 6 3
Re 5 7 1.99k
vde 7 0
vdb 2 4
Q1 3 4 5 Q2N2222A
.model Q2N2222A NPN(IS=8.11E-14 BF=205 VAF=113 IKF=0.5 ISE=1.06E-11 NE=2 BR=4 VAR=24
IKR=0.225 RB=1.37 RE=0.343 RC=0.137 CJE=2.95E-11 TF=3.97E-10 CJC=1.52E-11 TR=8.5E-8 XTB=1.5)
.dc vin 0 12 12
* Control Statements
.control
 run
*white background
set color0=white
* black grid and text (only needed with X11, automatic with MS Win)
set color1=black
* wider grid and plot lines
set xbrushwidth=2
print v(3,5) v(5) i(vdc) i(vde) i(vdb)
.endc
.end
```

```
No. of Data Rows : 2
                                        *bjt
                                        DC transfer characteristic  Wed Dec 29 18:51:52  2021
--------------------------------------------------------------------------------
Index   v-sweep         v(3,5)          v(5)            i(vdc)
--------------------------------------------------------------------------------
0       0.000000e+00    -9.50284e-25    9.560875e-25    -1.16064e-30
1       1.200000e+01    5.137738e+00    1.962002e+00    9.800520e-04
                                        *bjt
                                        DC transfer characteristic  Wed Dec 29 18:51:52  2021
--------------------------------------------------------------------------------
Index   v-sweep         i(vde)          i(vdb)
--------------------------------------------------------------------------------
0       0.000000e+00    4.804460e-28    4.816066e-28
1       1.200000e+01    9.859306e-04    5.878563e-06
```

By taking R1=36kohm, Rc=5kohm , Re=2kohm then the values of Ve=2v,Vce=5v,Ic=1mA,Ie=1mA,Ib=0.005mA (these values are from calculations)

*bjt

vin 8 0 dc=0 ac=100m

vcc 1 0 12

R1 1 2 36k

R2 2 0 10k

Rc 1 6 5k

vdc 6 3

Re 5 7 1.99k

vde 7 0

vdb 2 4

Q1 3 4 5 Q2N2222A

cb 2 8 2.040u

cc 6 9 4.080u

Rl 9 0 1k

ce 5 0 8u

.model Q2N2222A NPN(IS=8.11E-14 BF=205 VAF=113 IKF=0.5 ISE=1.06E-11 NE=2 BR=4 VAR=24 IKR=0.225 RB=1.37 RE=0.343 RC=0.137 CJE=2.95E-11 TF=3.97E-10 CJC=1.52E-11 TR=8.5E-8 XTB=1.5)

.ac dec 1000 100 100G

* Control Statements

.control

run

*white background

set color0=white

* black grid and text (only needed with X11, automatic with MS Win)

set color1=black

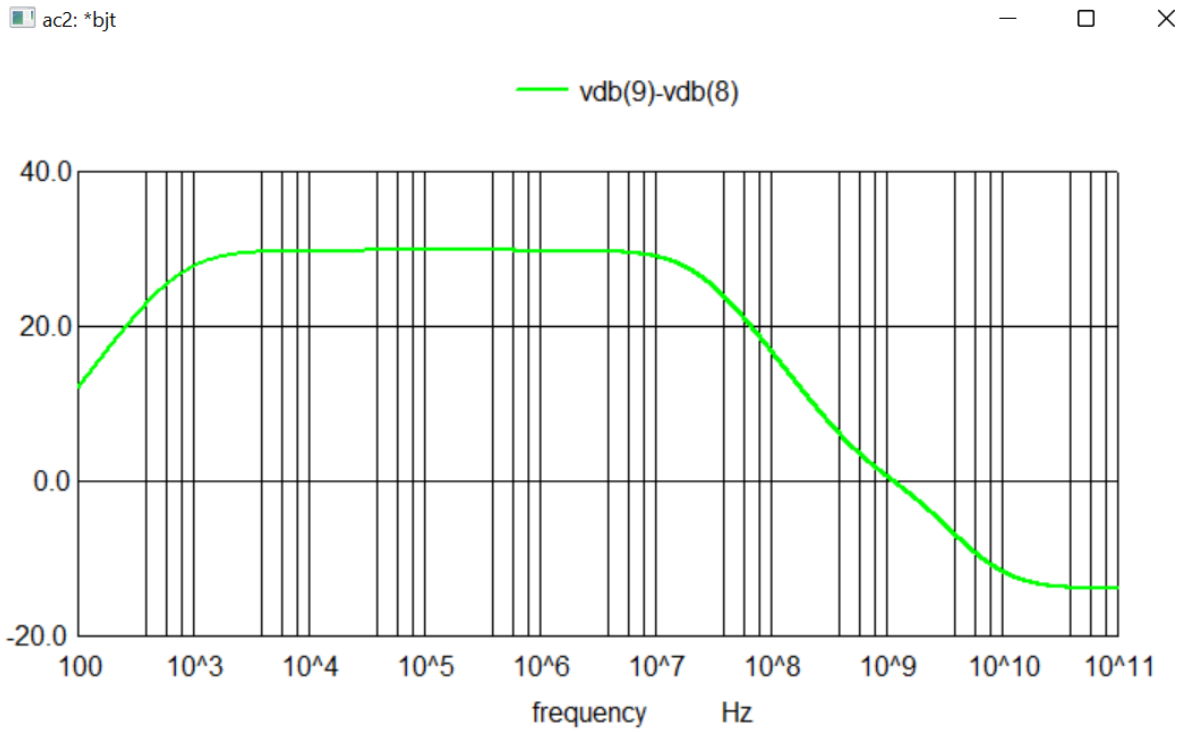
* wider grid and plot lines

set xbrushwidth=2

plot vdb(9)-vdb(8) xlog

.endc

.end



Now here the frequency 2kHz is in mid band region by using Cc=4.08 uF ,Cb=2.04 uF ,Ce=8 uF

*bjt

vin 8 0 Sin(0 100m 2k 0 0 0)

vcc 1 0 12

R1 1 2 36k

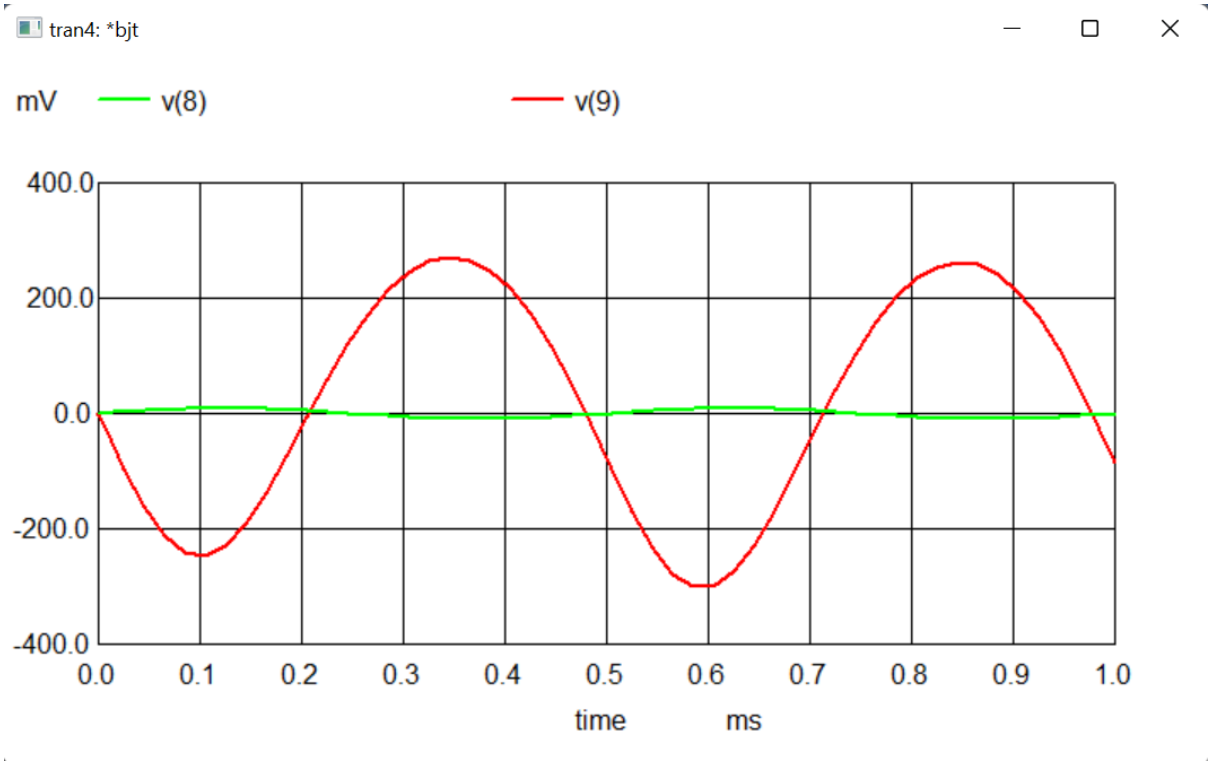
R2 2 0 10k

Rc 1 6 5k

vdc 6 3

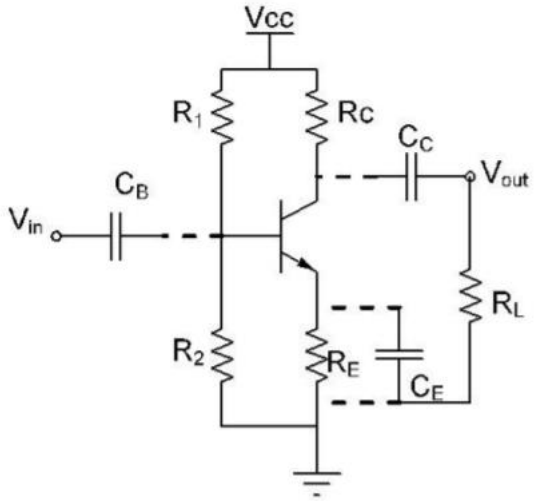
Re 5 7 1.99k

```
vde 7 0

vdb 2 4

Q1 3 4 5 Q2N2222A

cb 2 8 2.040u

cc 6 9 4.080u

Rl 9 0 1k

ce 5 0 8u

.model Q2N2222A NPN(IS=8.11E-14 BF=205 VAF=113 IKF=0.5 ISE=1.06E-11 NE=2 BR=4 VAR=24
IKR=0.225 RB=1.37 RE=0.343 RC=0.137 CJE=2.95E-11 TF=3.97E-10 CJC=1.52E-11 TR=8.5E-8 XTB=1.5)

.tran 0.1ms 1ms

* Control Statements

.control

 run

*white background

set color0=white

* black grid and text (only needed with X11, automatic with MS Win)

set color1=black

* wider grid and plot lines

set xbrushwidth=2


plot v(8) v(9)


.endc

.end
```



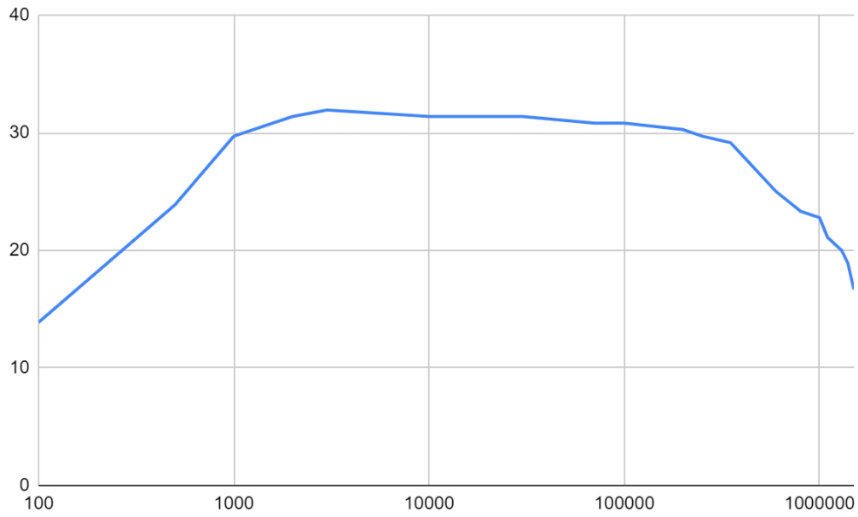
output voltage waveform and input voltage waveform for Vin = 100 mVp−p at 2 kHz.

Observations :



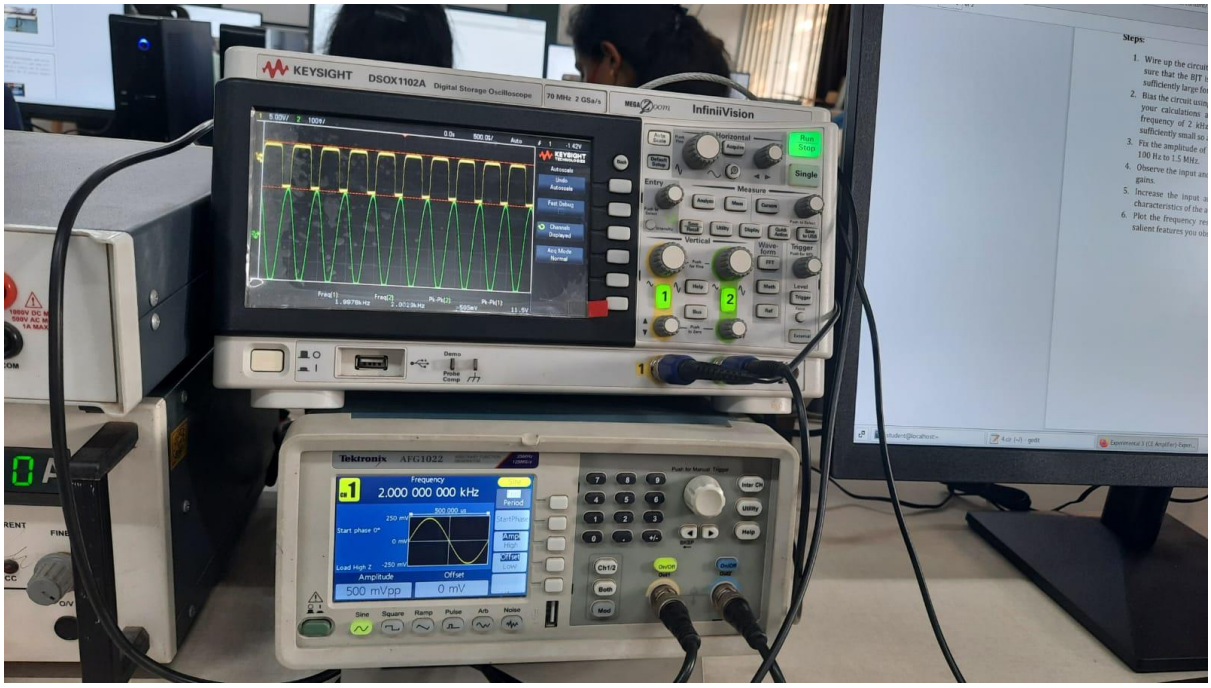
1. We have made the hardware setup as shown in the above figure
2. We observed that we got the output shown in oscilloscope is nearly same like which we got in simulation
3. When we varied frequencies from 100hz to 1.5Meg Hz we got different gains for different frequencies and the data is given below

Frequencies (in Hz)	Input voltage (in V)	Output voltage(in V)	Gain
100	0.36	5	13.88888889
500	0.36	8.6	23.88888889
1000	0.36	10.7	29.72222222
2000	0.36	11.3	31.38888889
3000	0.36	11.5	31.94444444
10000	0.36	11.3	31.38888889
30000	0.36	11.3	31.38888889
70000	0.36	11.1	30.83333333
100000	0.36	11.1	30.83333333
200000	0.36	10.9	30.27777778
250000	0.36	10.7	29.72222222
350000	0.36	10.5	29.16666667
450000	0.36	9.8	27.22222222
600000	0.36	9	25
800000	0.36	8.4	23.33333333
1000000	0.36	8.2	22.77777778
1100000	0.36	7.6	21.11111111
1300000	0.36	7.2	20
1400000	0.36	6.8	18.88888889
1500000	0.36	6	16.66666667

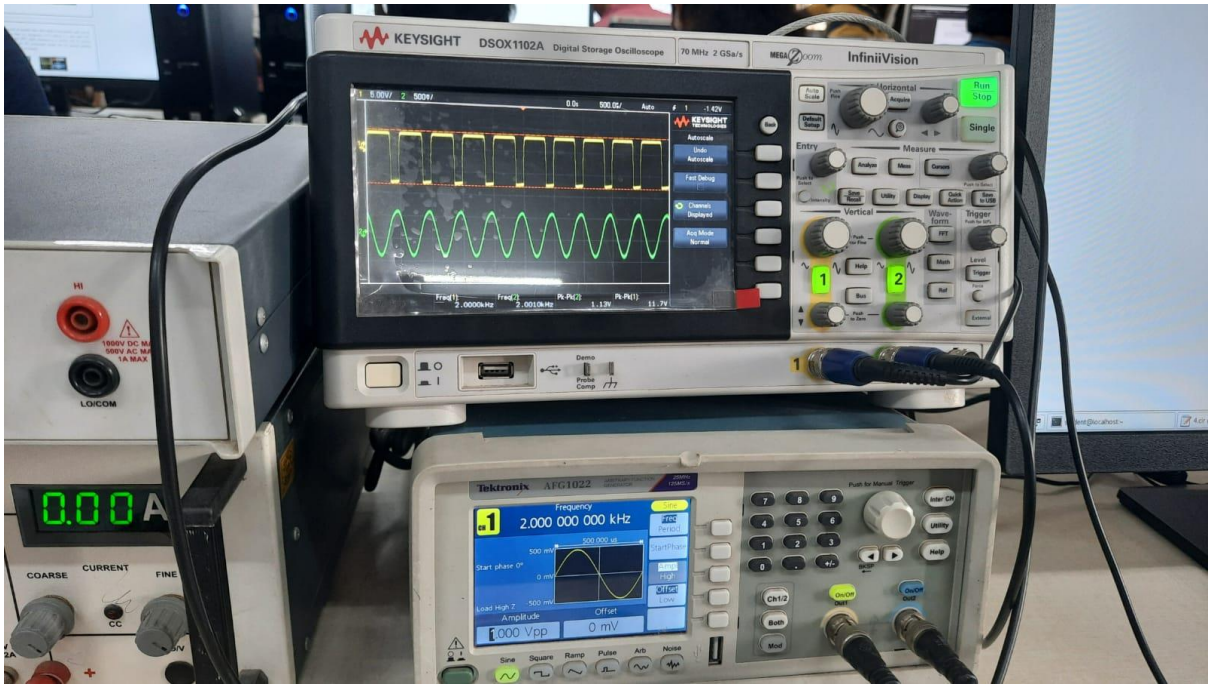


Graph: gain vs frequency

4. When we increased the input voltage to 500 mVp-p and 1 Vp-p then the clipping will happen to the output signal because the bjt will go to saturation after certain voltage that leads to clipping



Input output of amplifier when input voltage is 500 mVp-p



Input output of amplifier when input voltage is 1 Vp-p

The frequency response plot depicts that upto some frequency the gain is increasing and in the mid region the gain is constant and then again it starts decreasing as increase in frequency

Discussion :

200020051:

In lab 3 we did simulation of BJT model to understand common emitter amplifier properties and we used the oscilloscope and AFG for the first time and we did it well and the oscilloscope helped to see the signals clearly and to understand signals clearly and we did frequency response of BJT amplifier and we came to know about the gain at different frequencies

In this lab there are no issues as such ,but try to give the simulation exercise same as the lab exercise which it will help a lot to cross check the lab results with the simulation results

200020010:

Today in lab 3 we have done simulation and hardware excercise of BJT Common Emitter Amplifier. This lab helped me in understanding the behaviour and characterics of BJT. We understood about its frequency response and it's gain and also about mid-band region.

In hardware excercise we understood how to connect bjt with loads and power supply and with the help of oscilloscope , DSO we could compare the results we got in simulation with that of hardware results.

In third lab we were improved compared to first lab and we need to improve our speed in simulation in future labs.