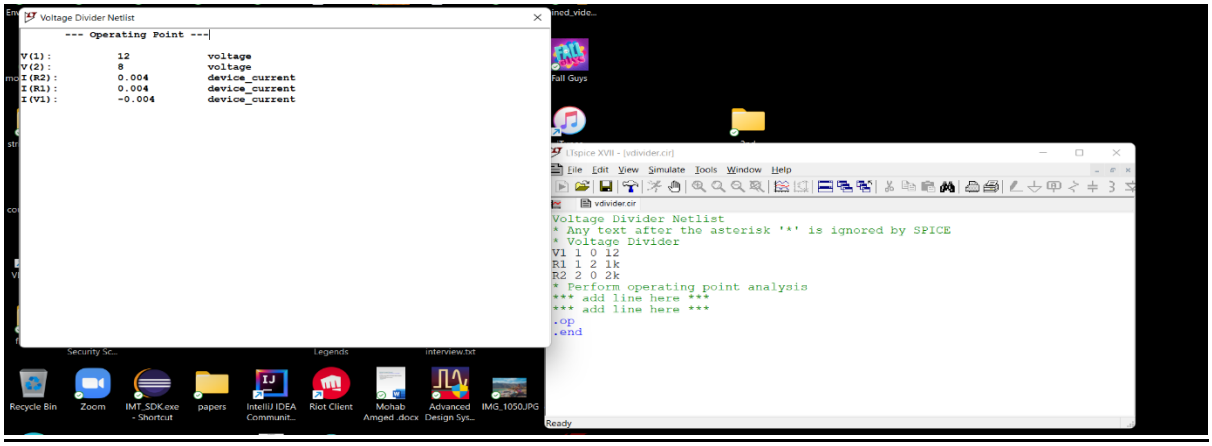
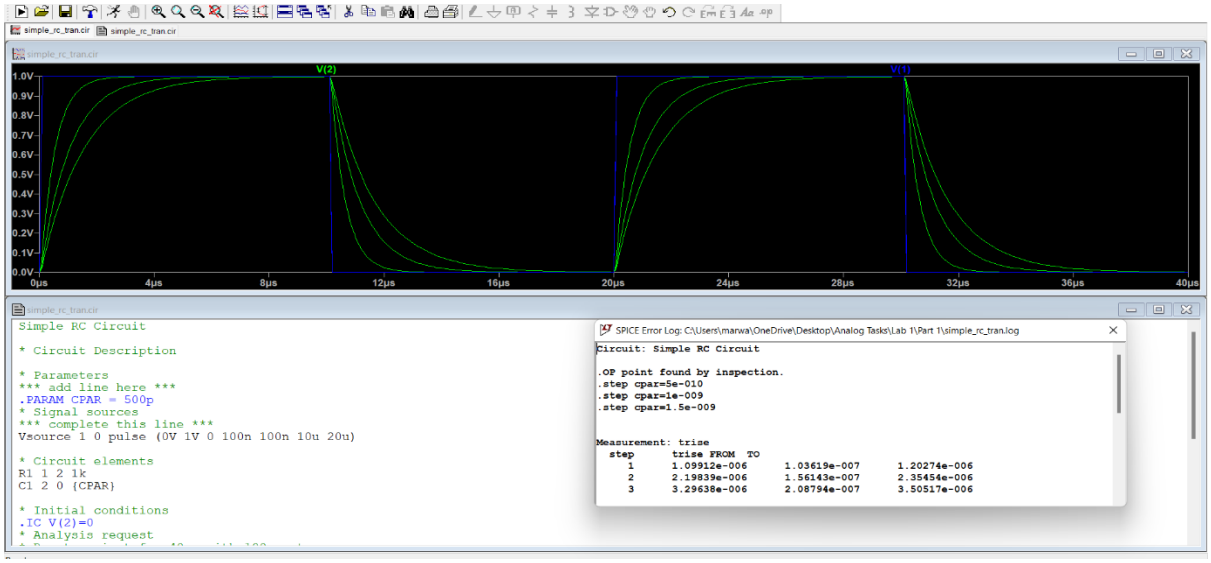
Part 1 :

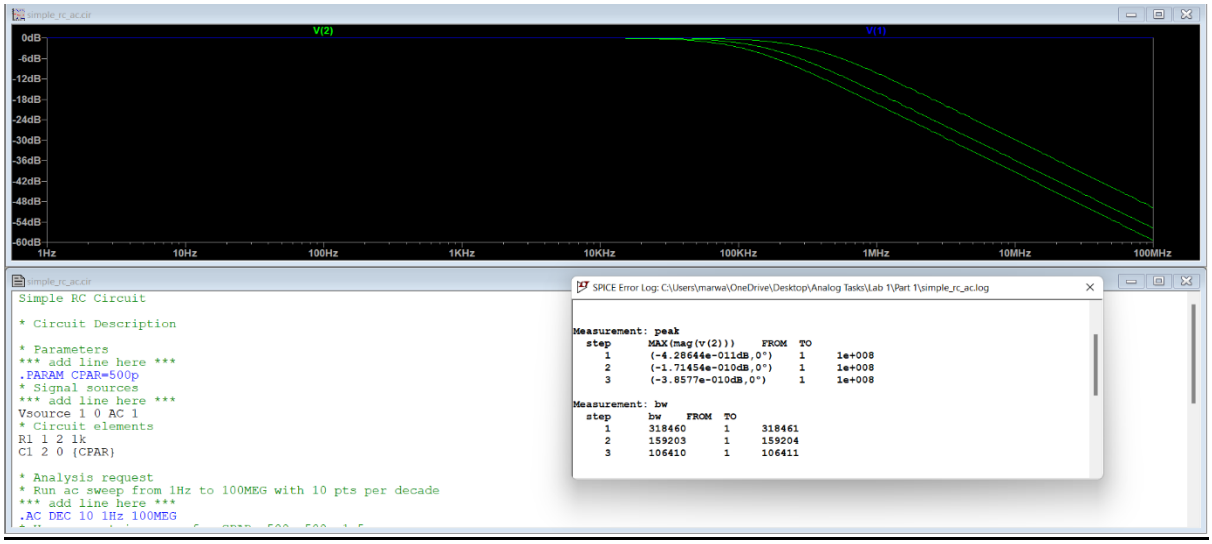
Question 1:



Question 2:



Question 3:



Part 2 :

Question 1 :

From the given data op-amp open loop gain will be 10000(gmR) and UGF 10 MEGAhz

Therefore a pole at 1Khz(RC=1/omega) so we have two equations to get R,C,gm.

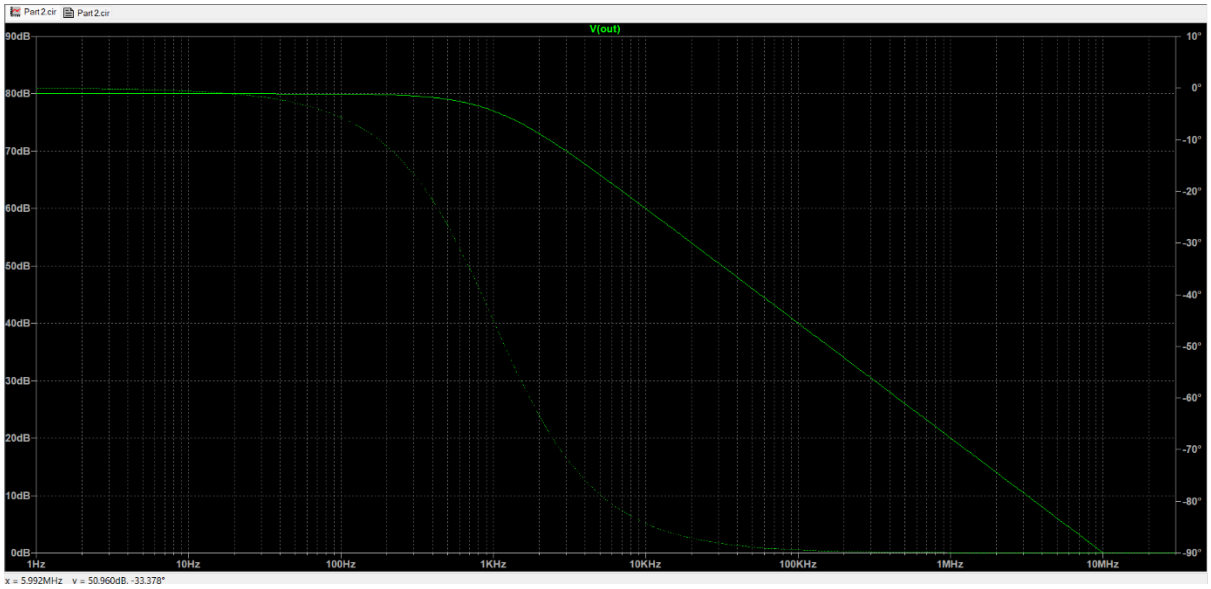
We no other constrains on the circuit elements so we can make an assumption for one element of the circuit, so let R=1k , from the equations gm =10, C=159.155n .

Op-amp sub Circuit Netlist:

/////There is a Typo error in one of the comments I meant Voltage Controlled Current Source not Current Controlled Voltage Source of This Pic.//////

```
.SUBCKT opamp 1 2 3
* Connections / / /
              * / / /
              * / / /
              * / / Vin-
              * / Vin+
              * /
    *     output node

* First Stage of the op amp

* Differential Inputs

* +Ve Terminal Open Current Source (Topology Requirement to have atleaset 2 connections to a node )
Iopen 2 0 0A

* -Ve Terminal Open Current Source (Topology Requirement to have atleaset 2 connections to a node )
Iopen1 3 0 0A


* Define the Current controled Voltage source controlled by the Differntial inputs
Gin 0 4 2 3 10

* Defining The Passive elements to get the required specs 10000 Gain and ugf 10 MHz
R1 4 0 1k
*G*R1=10000
C1 4 0 159.155n
* R*C = 1.5915E-4
* G*R=1+jwRC @ UGF

* First stage Completed


*  2nd Stage of the op amp

* Ideal Output Buffer

* Define The Voltage Controlled Voltage Source  with output equal to the voltage across the Rc Components
Eout 1 0 4 0 1

.ends opamp
```

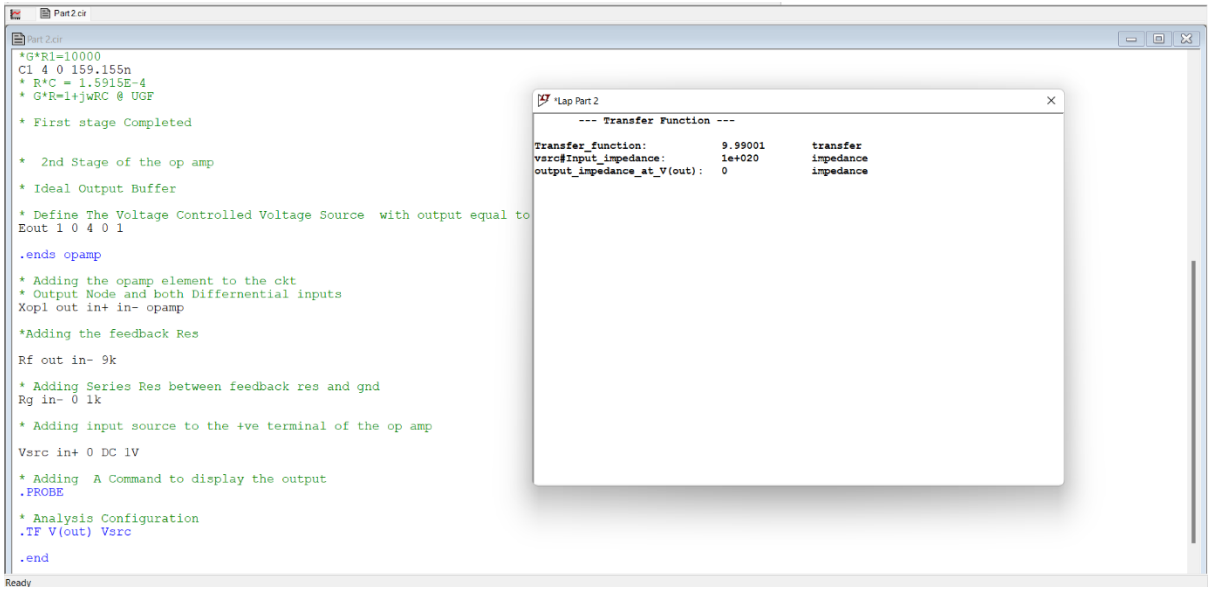
Op-Amp Sub Circuit Bode Plot: UGF=10Megahz , DC_Gain=80db → 10000



Question 2 :

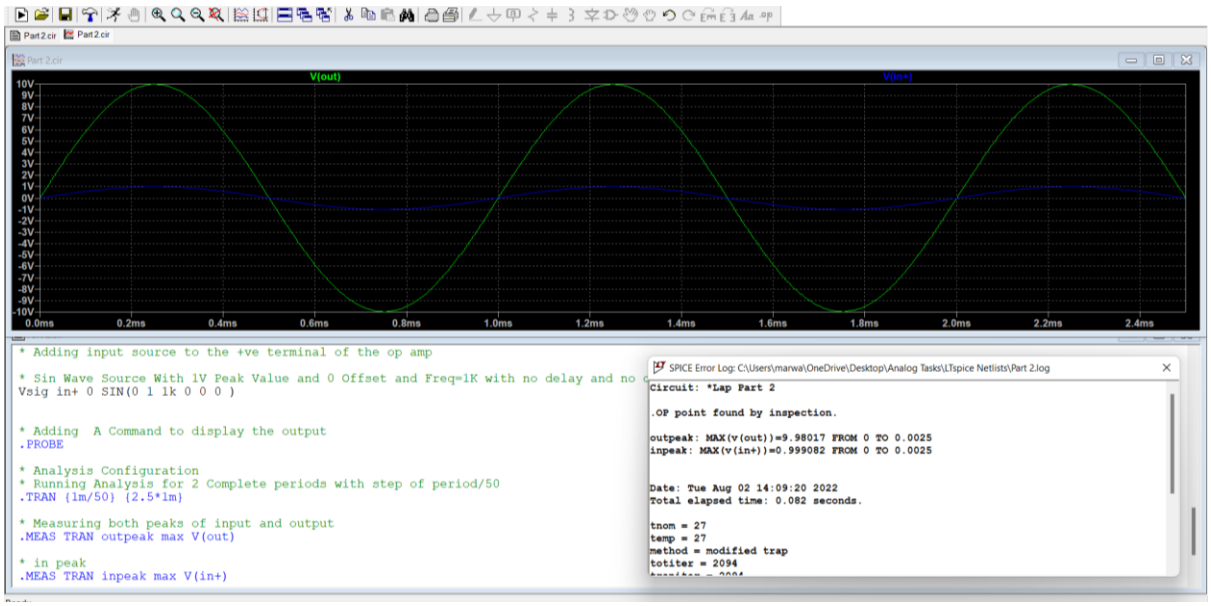
Non-Inverting Amp TF analysis using 1V DC :

Gain almost 10



Question 3 :

Transient Analysis using sine wave for 2 complete cycles of the input with Amp 1v and 1khz freq , Peak Values of Vsig and Vout found using measure command.



Question 4 :

The Voltage gain is 10

Hand Analysis	TF Analysis	Transient Analysis
A=1+(RF/R)=1+9/1=10	A=9.99001	A=Output Peak/ Input Peak A=9.98017/0.999082=9.989340214

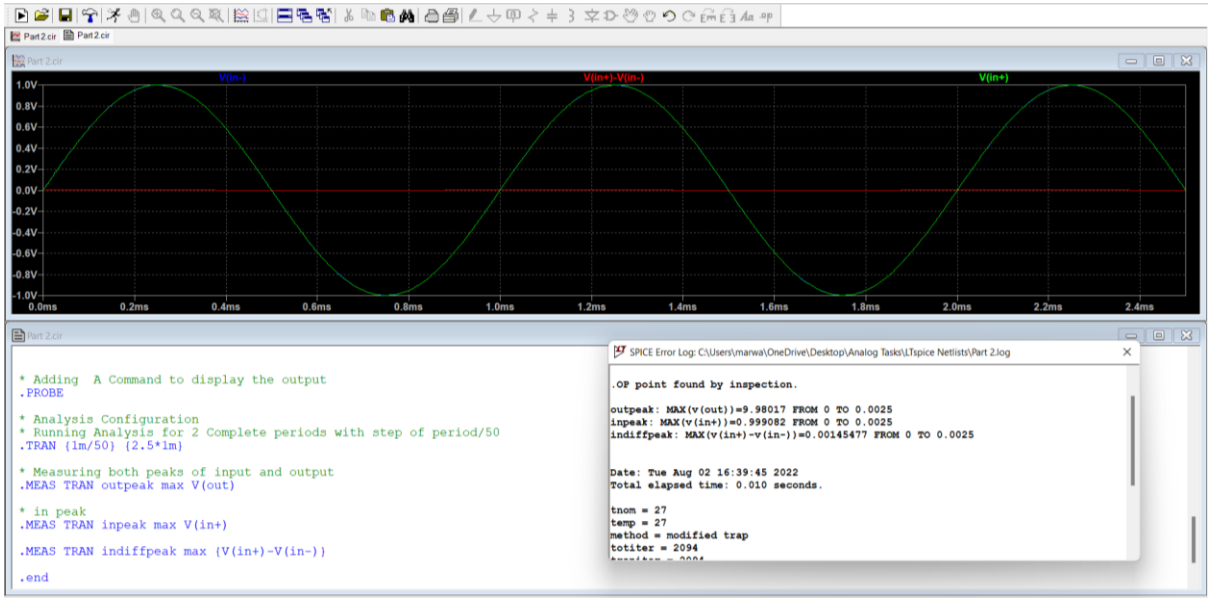
Hand Analysis is the ideal value of the gain , Transfer function and transient analysis is almost the same but the slight difference might be due to the solving of the differential equations at the transient analysis while solving easier model at the TF analysis.

(Both TF And Transient analysis are Accurate)

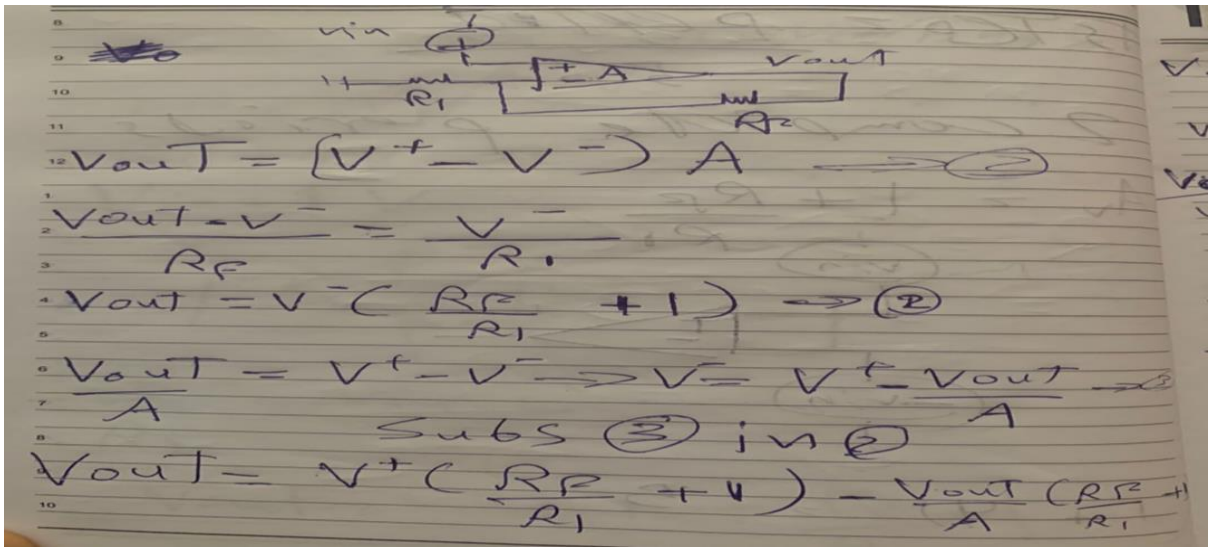
Question 5 :

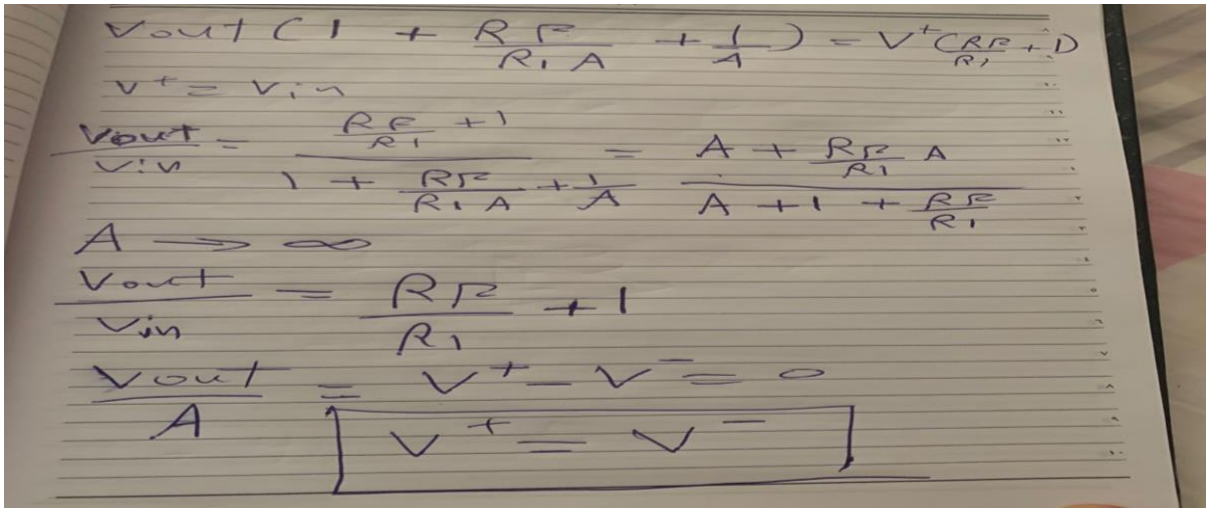
The Differential Input signal is the red signal amplitude Ideally is qual to 0 as Vin+ Ideally equal to Vin- due to the Very Large Gain and the -Ve feedback stables the system, See hand analysis.

At 1khz frequency (Within the BW) , Gain is very large Differential Input=0 :



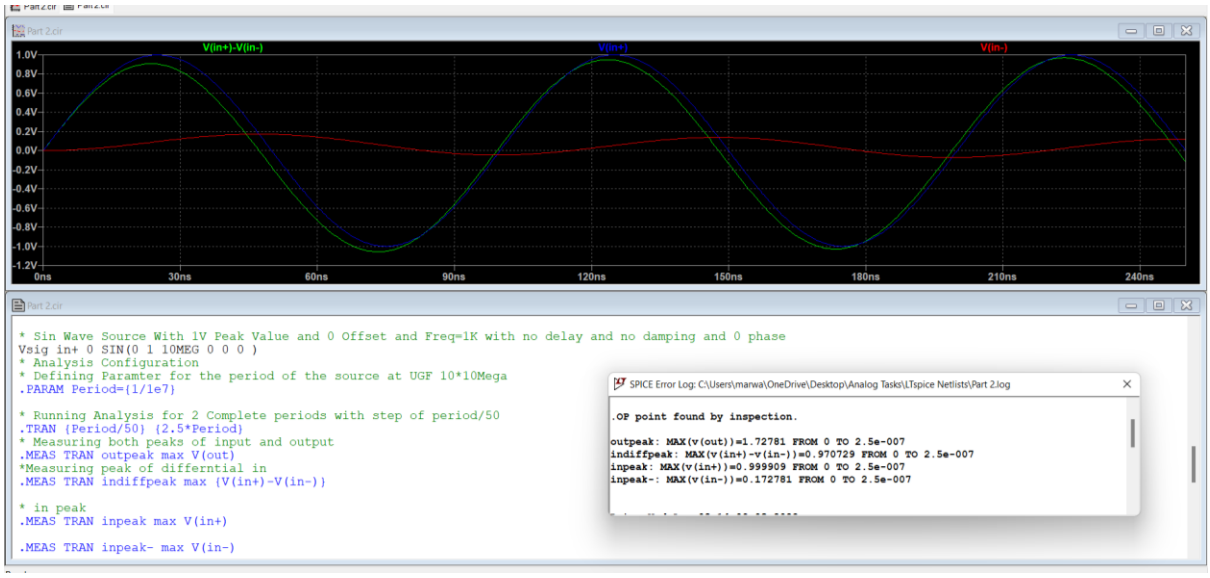
Hand Analysis :





Question 6:

At 10Megahz (UGF) Gain magnitude is Equal to 1 :



Comment:

Vin+ not equal to the Vin- as in the very large gain case ,

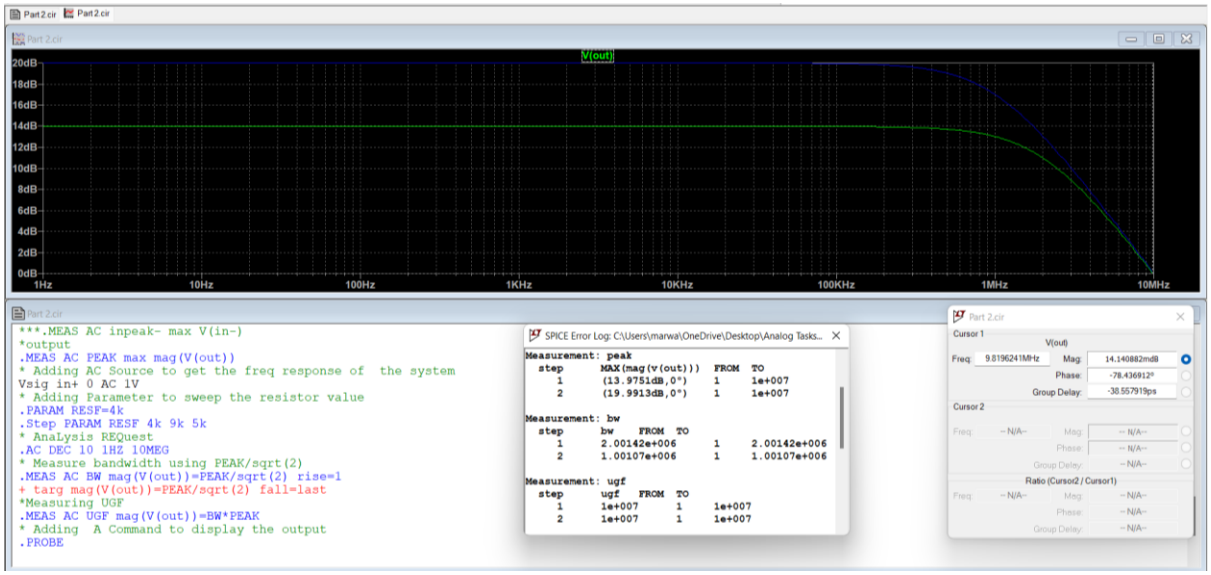
Vin-=1/10*Vout , Simulation Results are equal to the Hand analysis results.

Question 7:

Dc Gain and Bandwidth and UGF (GBW) Calculated using measure and visible in the figure , UGF Clear In the drawing 10 Megahz @ 0db → Vin=Vout,Gain=1.

14 db Gain for the 4k Resistor.

20 db Gain for the 9k Resistor.



Question 8:

No there will be no clipping , The Amplifier Amplifies the signal within The Bandwidth regarding its magnitude.

Question 9:

Comment:

The Results are almost the same from Hand Analysis and Ac Analysis (Ac Analysis is very accurate).

See Table below:

Type	Hand Analysis	AC Analysis
Gain	For 4K Resistor : Gain =5 , 14db For 9K Resistor : Gain =10 , 20db	For 4K Resistor : Gain =4.9975, 13.9751db For 9K Resistor : Gain =9.9899 , 19.9913db
Cut off Frequency	For 4K Resistor : F_c =2Mhz For 9K Resistor : F_c = 1Mhz	For 4K Resistor : F_c =2.00142Mhz For 9K Resistor : F_c = 1.00107Mhz
GBW(UGF)	For 4K Resistor : GBW=10Mhz For 9K Resistor : GBW= 10Mhz	For 4K Resistor : GBW=10.00209645Mhz For 9K Resistor : GBW= 10.00058919Mhz