

## **Problem no. 7**

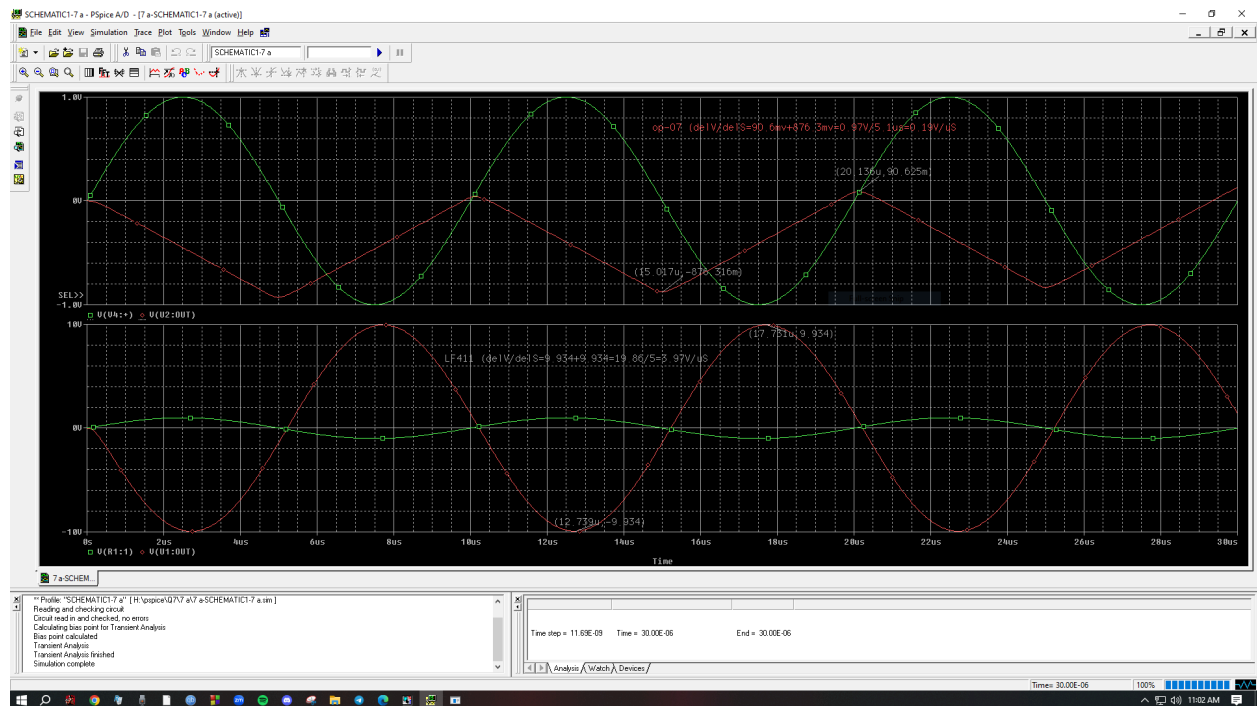
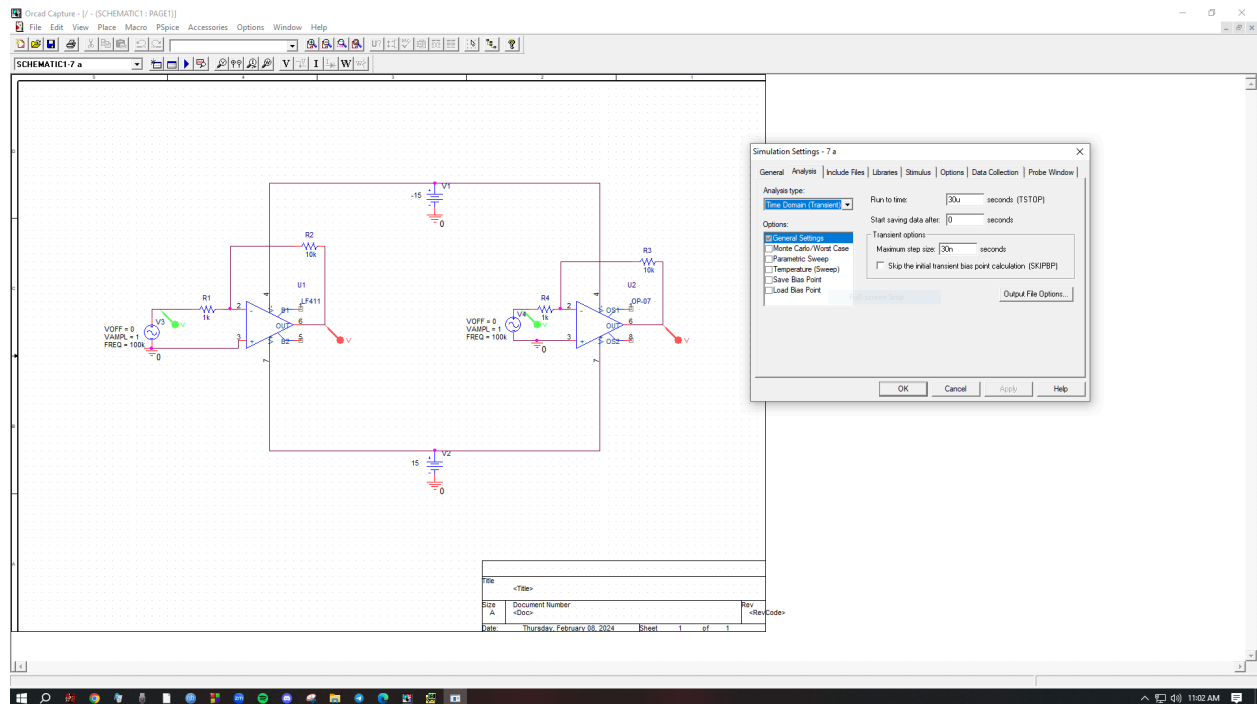
**7(a)** Find out the slew rate of the Op-Amp models LF411 and op-07 with the help of simulation.

**Calculation:**

**For LF411**

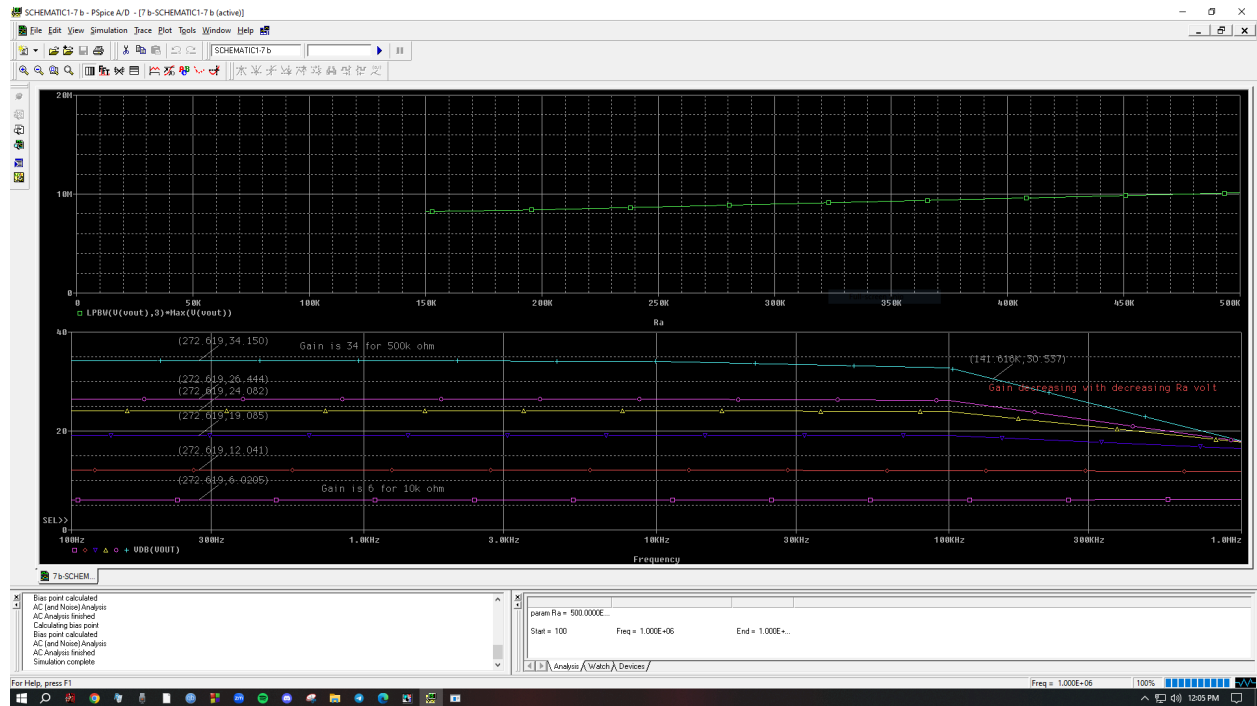
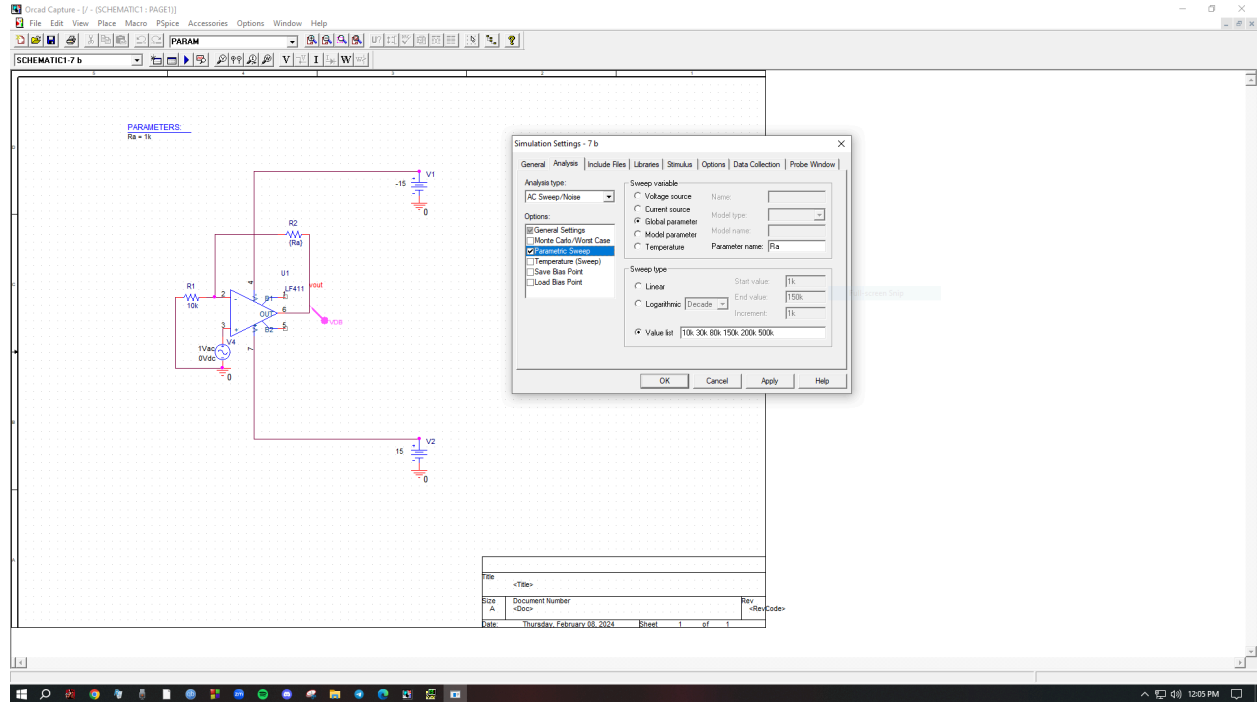
**$\Delta V / \Delta t = (9.934 - -9.934)\text{V} / 5\mu\text{s} = 19.86 / 5 = 3.9\text{V}/\mu\text{S}$  (Slew Rate)**

**For op-07 Slew Rate =  $(90.6\text{mV} - -876.3\text{mV}) / 5.1\mu\text{s} = 0.97 / 5.1 = 0.2\text{V}/\mu\text{S}$**

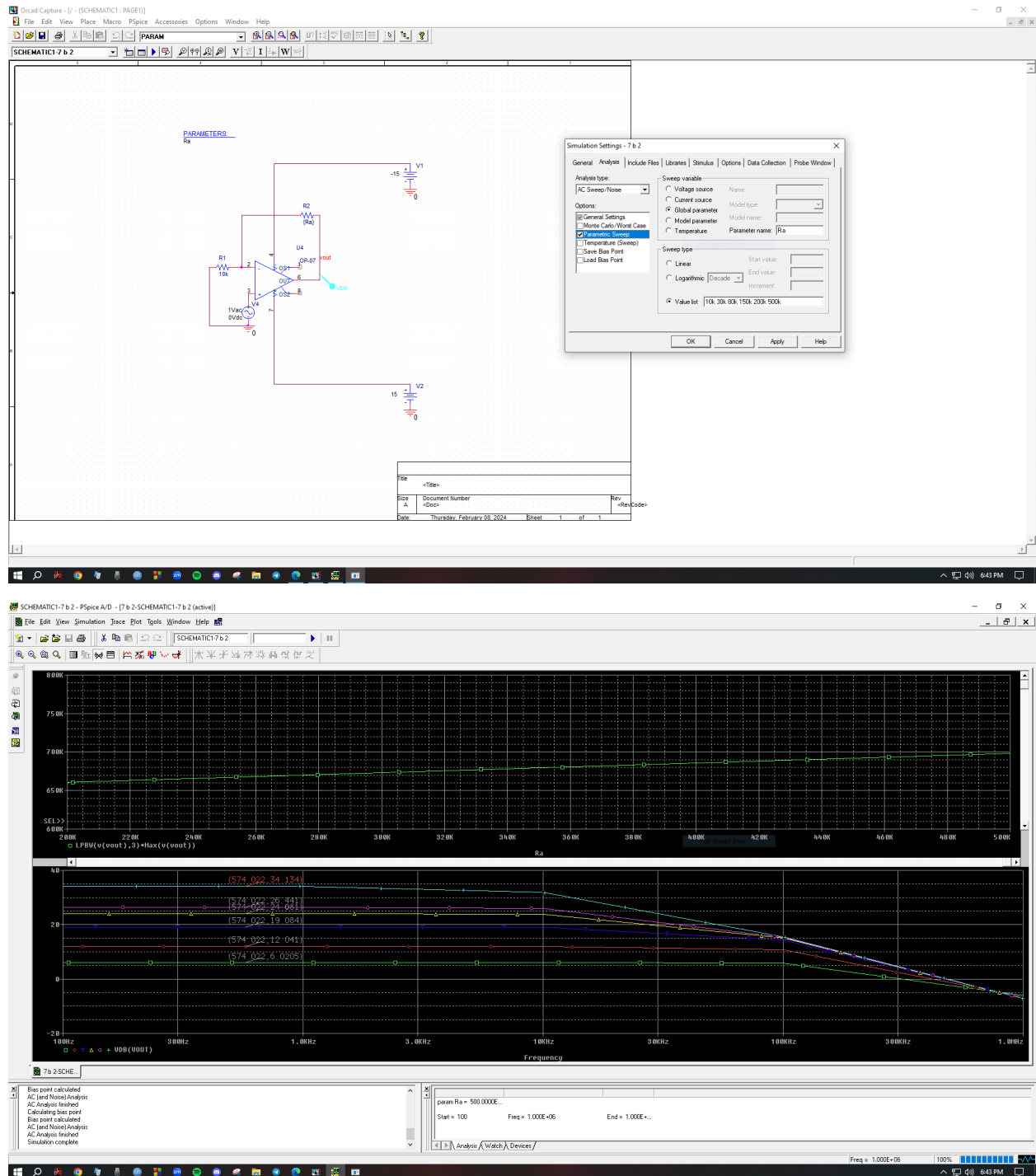


**(b) Show that the gain-bandwidth product of a non-inverting Op-Amp amplifier is constant for Op-Amp models LF411 and op-07.**

**For LF411:**

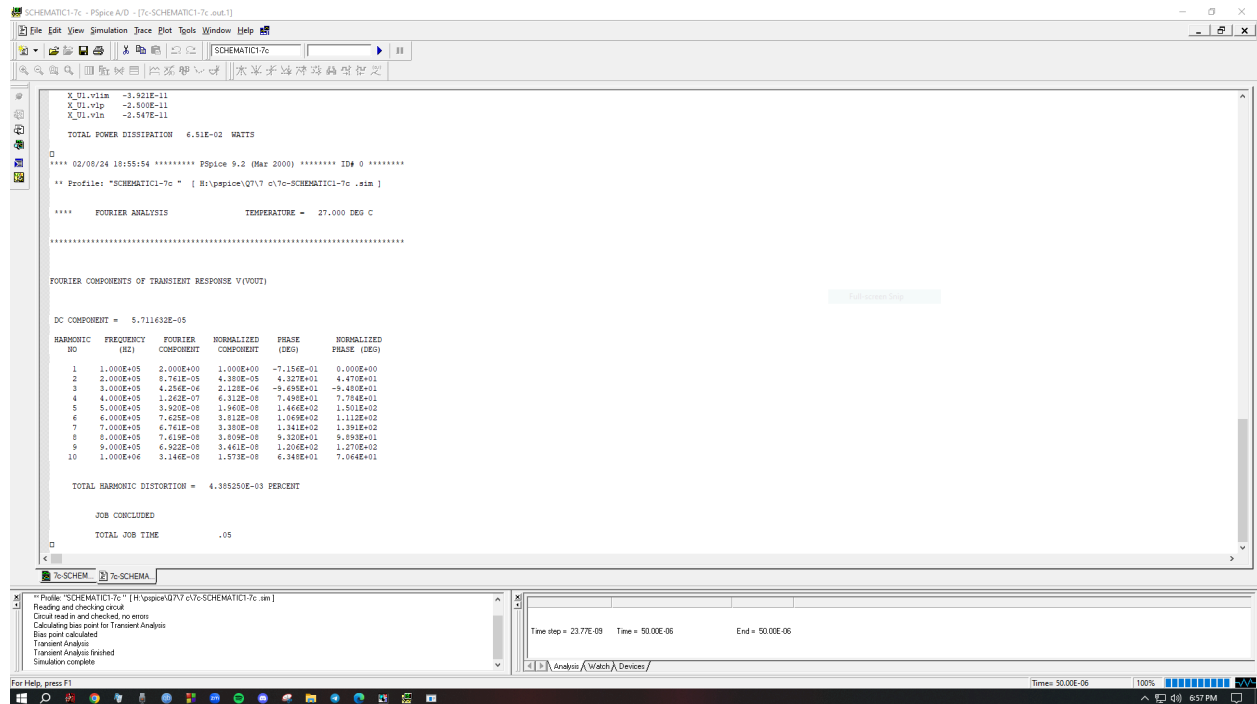
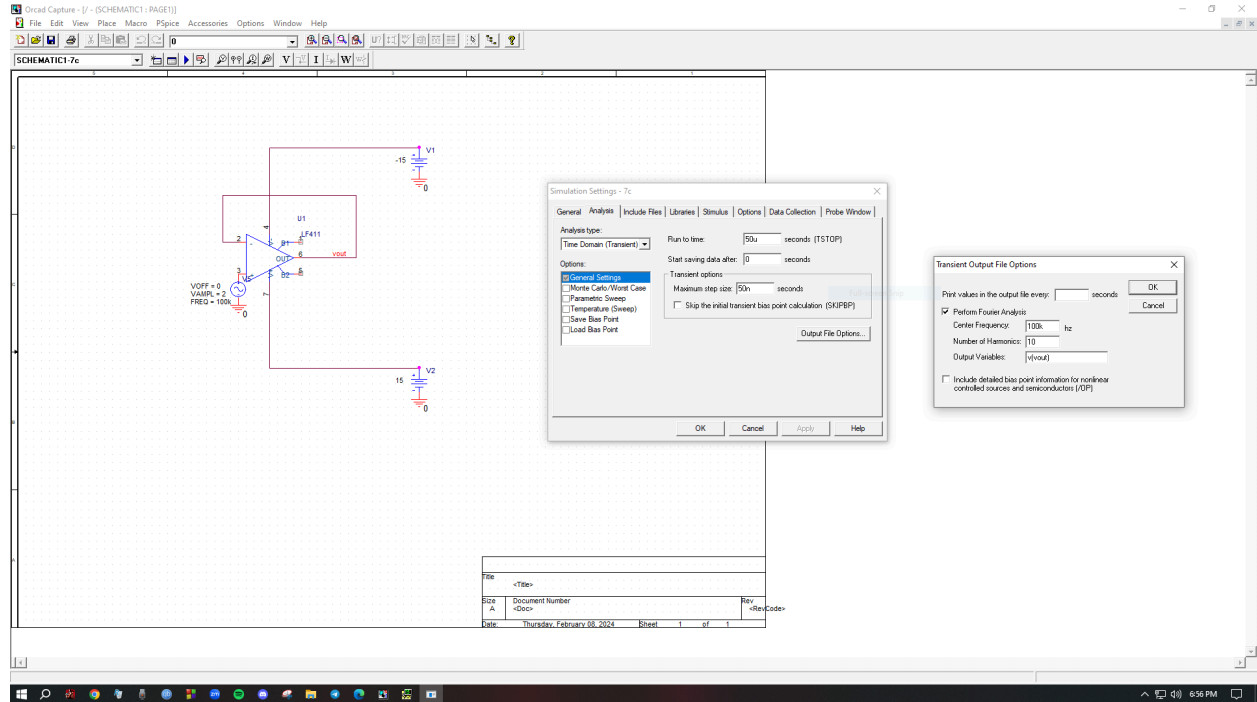


# For op-07:



**(c) Find out the total harmonic distortion (THD) of the output for Op-Amp models LF411 and op-07 based on buffer circuit when operated beyond its slew rate.**

**For LF411:**



# For op-07:

OrCAD Capture - [7 - (SCHEMATIC1-7 c 2)]

File Edit View Place Macro PSpice Accessories Options Window Help

SCHEMATIC1-7 c 2

Simulation Settings - 7 c 2

General Analysis Include Files Libraries Stimulus Options Data Collection Probe Window

Analysis type: Time Domain (Transient)

Run to time: 50u seconds (TSTOP)

Start saving data after: 0 seconds

Options:

- ☒ General Settings
- ☐ Monte Carlo Worst Case
- ☐ Parametric Sweep
- ☐ Temperature (Sweep)
- ☐ Save Bias Point
- ☐ Load Bias Point

Transient options:

Minimum step size: 50n seconds

☐ Skip the initial transient bias point calculation (SKIPBP)

Output File Options:

Print values in the output file every: seconds

☒ Perform Fourier Analysis

Center Frequency: 100k Hz

Number of Harmonics: 10

Output Variables: {vout}

☐ Include detailed bias point information for nonlinear controlled sources and semiconductor (JOP)

OK Cancel Apply Help

File Edit View Simulation Trace Plot Tools Window Help

SCHEMATIC1-7 c 2

Profile: "SCHEMATIC1-7 c 2" [H:\PSPICE\Q7\7 c 2\7 c 2-SCHEMATIC1-7 c 2.sim]

\*\*\*\* FOURIER ANALYSIS TEMPERATURE = 27.000 DEG C \*\*\*\*

FOURIER COMPONENTS OF TRANSIENT RESPONSE V(VOUT)

DC COMPONENT = 3.343194E-02

HARMONIC NO	FREQUENCY (Hz)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	1.000E+05	4.041E-01	1.000E+00	-0.124E+01	0.000E+00
2	2.000E+05	1.287E-03	3.183E-03	-1.515E+02	1.103E+01
3	3.000E+05	4.349E-04	1.078E-03	-0.338E+01	1.804E+02
4	4.000E+05	7.134E-04	1.765E-03	-1.020E+02	2.321E+02
5	5.000E+05	1.492E-02	3.693E-02	-4.480E+01	3.614E+02
6	6.000E+05	6.412E-04	1.556E-03	-7.430E+01	4.132E+02
7	7.000E+05	7.187E-03	1.777E-02	-2.558E+01	5.431E+02
8	8.000E+05	6.136E-04	1.518E-03	-5.404E+01	5.959E+02
9	9.000E+05	4.056E-03	1.011E-02	-6.247E+00	7.845E+02
10	1.000E+06	5.870E-04	1.452E-03	-3.740E+01	7.748E+02

TOTAL HARMONIC DISTORTION = 1.1164597E+01 PERCENT

JOB CONCLUDED

TOTAL JOB TIME .06

Time step = 31.61E-09 Time = 50.00E-06 End = 50.00E-06

Analysis (Watch) Devices /

Time: 50.00E-06 100%



**(d) Compare different parameters of Op-Amp models LF411 and op-07 based on results obtain by your analysis and simulation results.**

**ANS: Slew Rate: LF411 typically has a higher slew rate compared to OP-07. This means LF411 can handle faster changes in the input signal without distortion.**

**Gain-Bandwidth Product: Both LF411 and OP-07 should exhibit a relatively constant gain-bandwidth product in the non-inverting Op-Amp amplifier configuration, as you've shown in part (b). This property is inherent to the Op-Amp design and is maintained across various models.**

**Total Harmonic Distortion (THD): THD performance can vary between LF411 and OP-07, especially when operated beyond their slew rates. It's possible that LF411 exhibits lower THD compared to OP-07 under such conditions, but this would depend on specific operating conditions and the characteristics of the buffer circuit.**

**Noise Characteristics: LF411 and OP-07 may have different noise performance characteristics. This includes input noise voltage, input noise current, and overall noise figure. Depending on the application, one may be more suitable than the other.**

**Input Offset Voltage:** LF411 and OP-07 may have different input offset voltage specifications. Input offset voltage can affect the accuracy of the amplifier in DC-coupled applications.

**Input Bias Current:** LF411 and OP-07 may also have different input bias current specifications. Input bias current can impact the performance of the amplifier, particularly in high-impedance circuits.

**Supply Voltage Range:** LF411 and OP-07 may have different supply voltage requirements. This could influence their suitability for specific power supply configurations or battery-operated applications.

**Temperature Stability:** LF411 and OP-07 may exhibit different temperature coefficients and thermal stability characteristics. This is important for applications operating over a wide temperature range.