

Justin Hsu

EEC 100 Lab 3

10/21/24

(1) Objective: Learn how to calculate, build, and simulate a summing amplifier circuit by using three different input waveforms and input voltages.

(2) Prelab:

Prelab
 $f = 2000 \text{ Hz}$

Z_{in}

$C : \frac{1}{j(2\pi 2000)(0.33\mu)} = -241.144j$

$L : j(2\pi 2000)(100m) = 1256.637j$

$$\frac{1}{240 + 1256.637j} + \frac{1}{-241.144j} = \frac{1}{Z_{eq}}$$

$Z_{eq} = 12.817 - 295.38j$

$$= 295.66 \angle -87.515^\circ$$

$Z_{in} = 1012.817 - 295.38j$

(3) Simulation:

$$f = 100 \text{ Hz}$$

$$V_{max} = 802.09 \text{ mV}$$

$$(0.802)^{-1} = 1.25 \text{ k}\Omega$$

Trace Color	Trace Name	Y1	Y2	Y1 - Y2	Y1(Cursor1) - Y2(Cursor2)	-3.4815m			
X Values		5.0702m	5.9032m	73.002u	Y1 - Y2(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 2	VIR2:1	-47.851m	-2.0007m	-45.850m	-42.449m	0.003	-2.0027m	-47.853m	-24.928m
CURSOR 1	VIR2:1, R3:2	5.4042m	31.376m	-36.781m	0.000	33.379m	31.379m	-5.4842m	12.988m

$$t_d = 73 \text{ } \mu\text{s}$$

$$\phi = -t_d \times f \times 360^\circ$$

$$= -(-73 \times 10^{-6}) \times (100) \times 360^\circ$$

$$\boxed{\phi = +2.63^\circ}$$

$$1250 \angle +2.63^\circ = 1248.7 + 57.36j$$

$$f = 500 \text{ Hz}$$

$$V_{max} = 669 \text{ mV}$$

$$(0.669)^{-1} = 1.495 \text{ k}\Omega$$

Trace Color	Trace Name	Y1	Y2	Y1 - Y2	Y1(Cursor1) - Y2(Cursor2)	569.599u			
X Values		9.0534m	9.9003m	0.8469m	Y1 - Y2(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 2	VIR2:1	-197.707m	-971.444m	-196.736m	-197.385m	0.003	-971.444m	-197.737m	-99.338m
CURSOR 1	VIR2:1, R3:2	401.946m	138.617m	-131.319m	0.000	131.598m	138.617m	-401.846m	66.108m

$$t_d = 63 \mu\text{s}$$

$$\phi = -t_d \times f \times 360^\circ$$

$$= -(-63 \times 10^{-6})(500)(360^\circ)$$

$$\phi = +11.34^\circ$$

$$1495 \angle -11.34^\circ = 1493.8 + 273.96j$$

$$f = 1000 \text{ Hz}$$

$$V_{\max} = 516.448$$

$$(0.516)^{-1} = 1.94 \text{ k}\Omega$$

Trace Color	Trace Name	Y1	Y2	Y1 - Y2	Y1(Cursor1) - Y2(Cursor2)	-5.5094m	Max Y	Min Y	Avg Y
	X Values	5.4502m	4.9322m	73.000s	Y1 - Y1(Cursor1) - Y2 - Y2(Cursor2)				
CURSOR 2	V(R2-1)	-34.041m	11.152m	-45.233m	-39.724m	0.000	11.152m	-34.041m	-11.425m
CURSOR 1	V(R2-1,R3-2)	5.6827m	41.948m	36.266m	0.008	30.756m	41.948m	5.6827m	23.816m

$$t_d = 73 \mu s$$

$$\phi = -t_d \times f \times 360^\circ$$

$$= -(73 \times 10^{-6}) \times 1000 \times 360^\circ$$

$$\phi = -26.28^\circ$$

$$1940 \angle -26.28^\circ = 1739 - j59.6j$$

$$f = 2000 \text{ Hz}$$

$$V_{\max} = 944.823 \text{ mV}$$

$$(0.944)^{-1} = 1.06 \text{ k}\Omega$$

Trace Color	Trace Name	Y1	Y2	Y1 - Y2	Y1(Cursor1) - Y2(Cursor2)	2.1322m	Max Y	Min Y	Avg Y
	X Values	5.2273m	5.2500m	.2275m	Y1 - Y1(Cursor1) - Y2 - Y2(Cursor2)				
CURSOR 2	V(R2-1)	281.705m	-347.001m	282.130m	279.594m	0.000	281.705m	-347.001m	140.719m
CURSOR 1	V(R2-1,R3-2)	1.791m	-264.767m	266.580m	0.006	-264.449m	1.791m	-264.767m	-131.563m

$$t_d = 23 \mu s$$

$$\phi = -t_d \times f \times 360^\circ$$

$$= - (23 \times 10^{-6}) \times 2000 \times 360^\circ$$

$$\phi = -16.56^\circ \quad 1060 \angle -16.56^\circ = 1016 - j302.1j$$

(4) Experiment:

$$1000 \text{ Hz} \quad t_d = 7845$$

$$\phi = (1000) \times 7845 \times 360 = -2808^\circ$$

$$I_1 = \frac{U_1}{R_1} = \frac{170 \text{ mV}}{1000} = 0.17 \times 10^{-3}$$

$$|Z_1| = \frac{V}{I} = \frac{1}{0.17 \times 10^{-3}} = 2127.66$$

$$z = 2127.66 \angle -28^\circ$$

$$2000 \text{ Hz} \quad t_d = 3045$$

$$\phi = -2000 \times 3045 \times 360 = 10.8^\circ - 21.6^\circ$$

$$I_1 = \frac{U_1}{R_1} = \frac{930 \text{ mV}}{1000} = 0.93 \times 10^{-3}$$

$$|Z_1| = \frac{V}{I} = \frac{1}{0.93 \times 10^{-3}} = 1075.26$$

$$1075.26 \angle -21.6^\circ$$

$$z = 1000 \rightarrow 365.83 j$$

EEC 100 Lab 4

$$100Hz \quad t_d = -0.08ms$$

$$\phi = 100 \times -0.08 \times 10^3 \times 360$$

$$\phi = -2.4^\circ$$

$$I_1 = \frac{V_1}{R_1} = \frac{810mV}{1000\Omega} = 0.81 \times 10^{-3}$$

$$|Z| = \frac{V_1}{I_1} = \frac{1V}{(0.81 \times 10^{-3})} = 1234.567 \Omega$$

$$1234.567 \times +2.4^\circ = 1234$$

$$Z = 1233.484 + 51.698j$$

$$500 + Z \quad t_d = 0.08ms$$

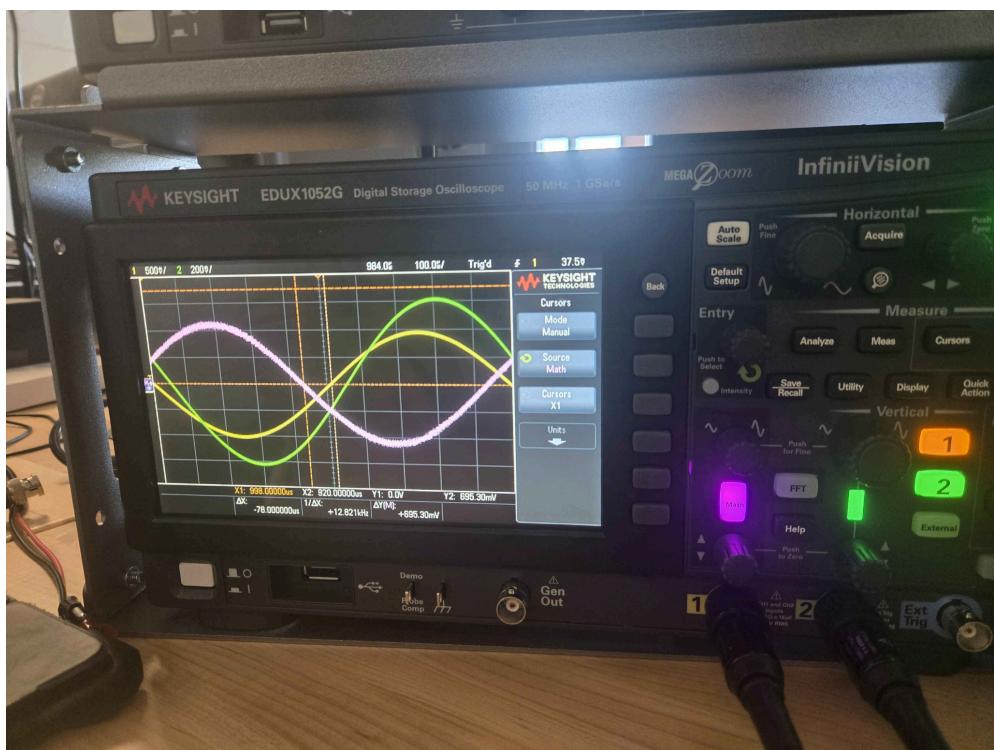
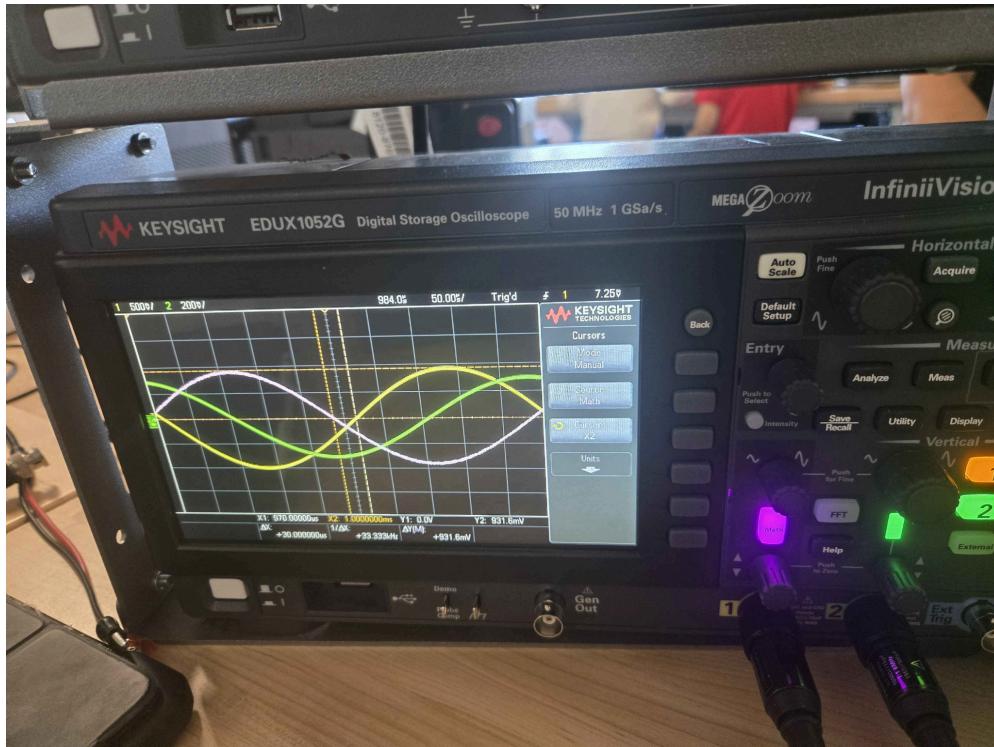
$$\phi = 500 \times (-0.08 \times 10^3) \times 360 = -2.4^\circ 11.52^\circ$$

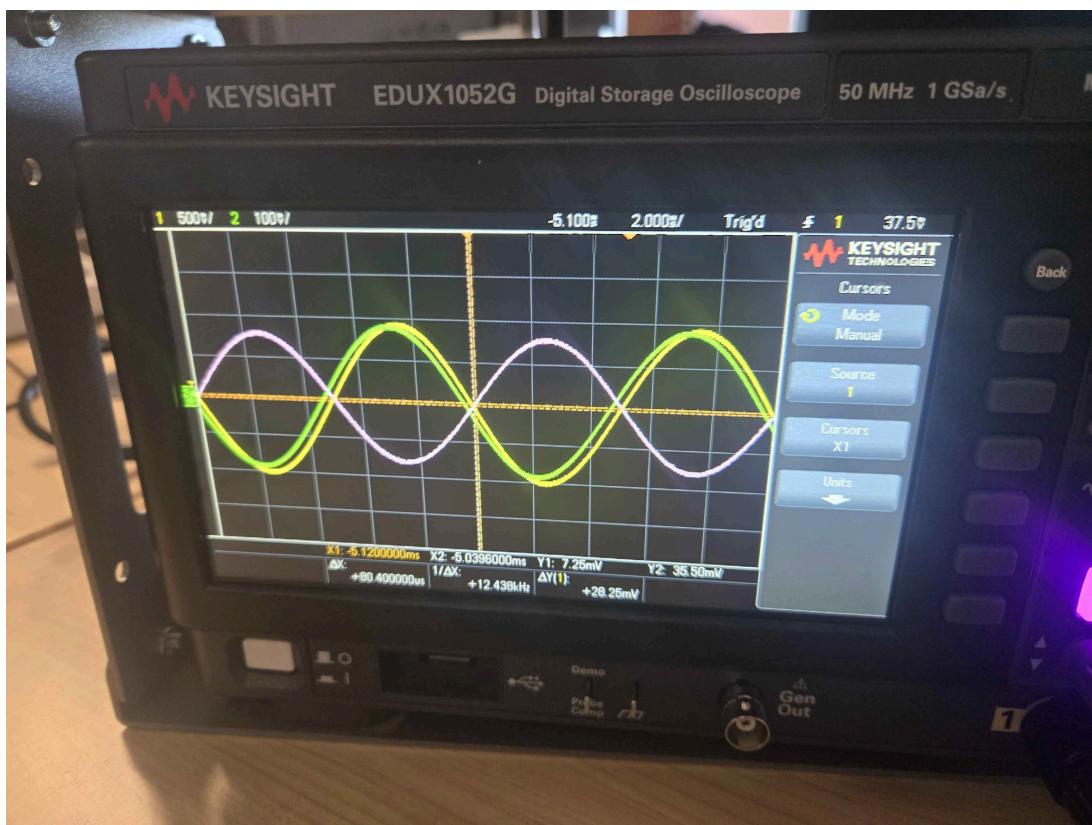
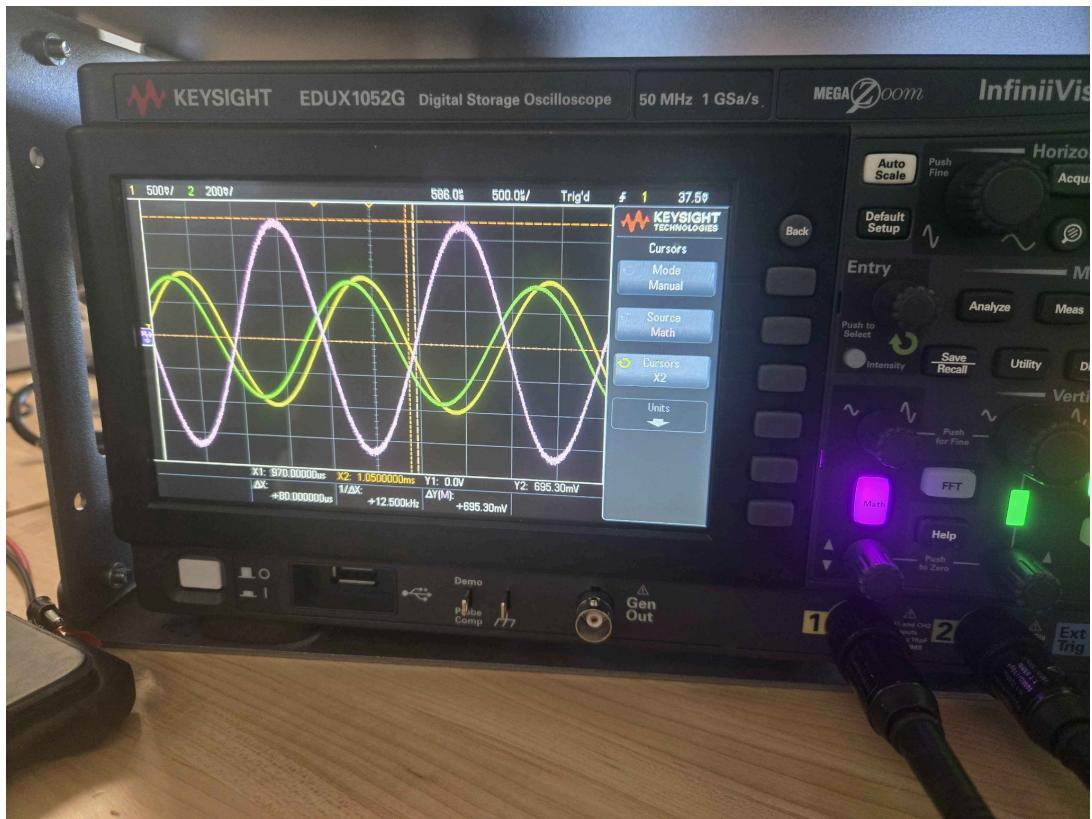
$$I_1 = \frac{V_1}{R_1} = \frac{700mV}{100\Omega} = 7 \times 10^{-3}$$

$$|Z| = \frac{1V}{7 \times 10^{-3}} = 142.857 \times -2.4^\circ 11.52^\circ$$

$$\phi = 140.57$$

$$Z = 1401.57 + 235.24j$$





(5) Conclusion:

The prelab calculations I made and the SPICE simulation agreed with our experimental results (even though the experimental results were a little off due to the inherent variance of our components). We learned that with a varying input frequency, the impedance of our circuit would change due to the impedance definitions of the capacitor and inductor being dependent on the frequency of the input source.

(6) Checkoff:

UNIVERSITY OF CALIFORNIA, DAVIS
Department of Electrical and Computer Engineering

EEC 100 Circuits II Fall 2024

Lab Number 34

Student Name	Pre-Lab	Simulation	Experiment	Total	T.A. Signature	Date
Daniel Nareviuk	B	B	C	80	J.C.	10/22
Justin	B	R	C	75		

T.A. Comments: