Answer Key

1.1.1

TABLE 1 :

	a)	b)	c)
V_{out}	-20V	-24V	-24V
Gain	-2	-2.4	-2.4

a)

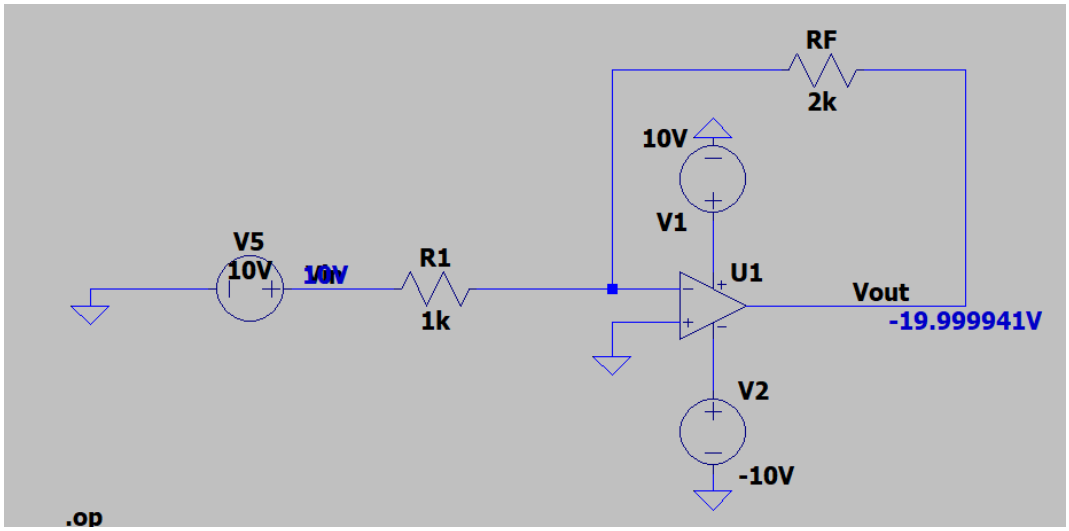


Figure 1 : Vout for a)

b)

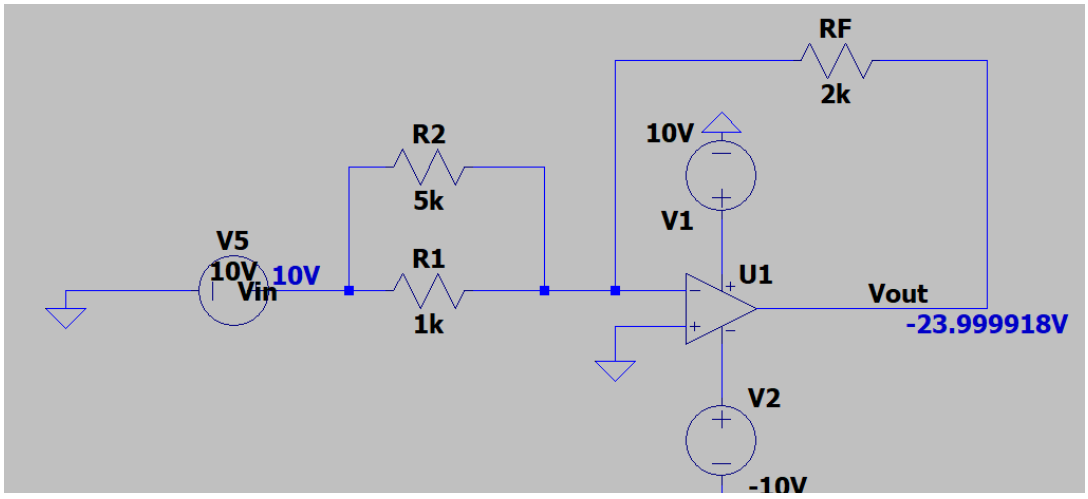


Figure 2 : Vout for B)

c)

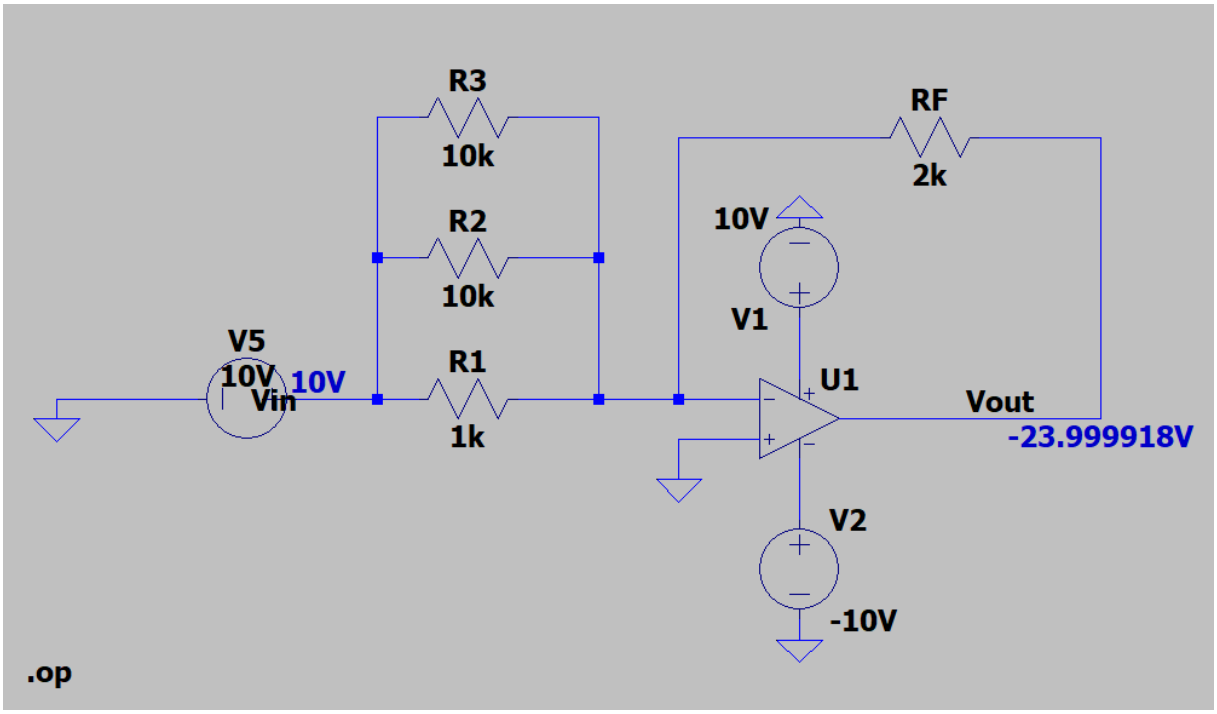


Figure 3 :Vout for c)

FOR B) →

V0=Rf(V1/R1+V2/R2)

Vout = - 2k * (10/5 + 10/ 1) = -24V

Gain = Vout/ Vin = -2.4= A1+A2+A3

A1 =- Rf/R1 = -2

A2 =- Rf/R2 = -0,5

FOR C) →

V0=Rf(V1/R1+V2/R2+V3/R3)

Vout = - 2k * (10/10 + 10/ 10 + 10/1) = -24V

A1 =- Rf/R1 = -2

A2 =- Rf/R2 = -0,2

A3 =- Rf/R3 = -0,2

Gain = Vout/ Vin = - 2.4 = A1+A2+A3

Farklı devreler olsalar da B'deki kazanç ile C'deki kazancın birbirine eşit olduğu görülmüştür.

1.1.2

a)

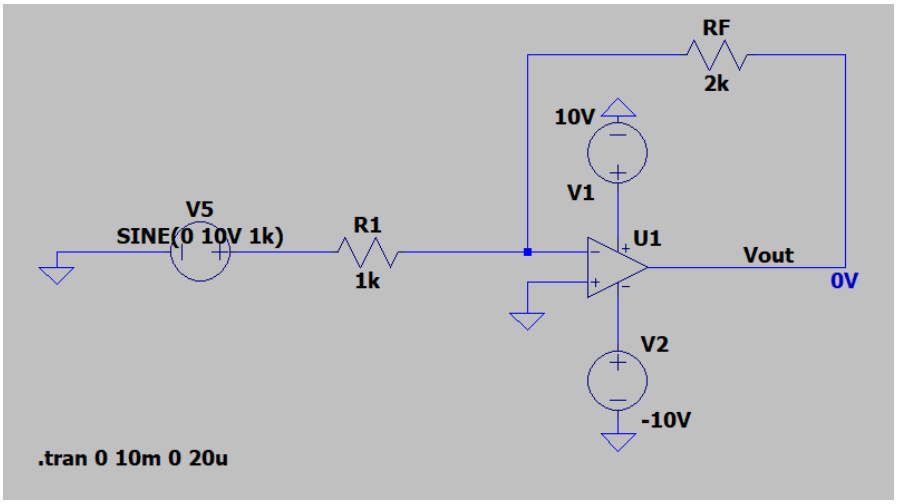


Figure 4 : Circuit for AC voltage

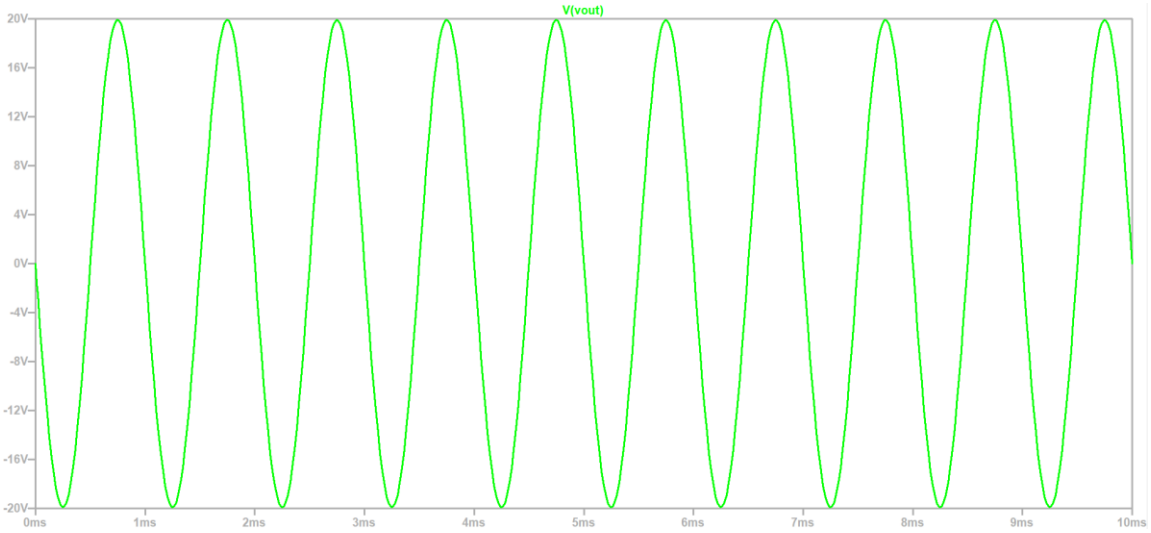


Figure 5: Simulation Result

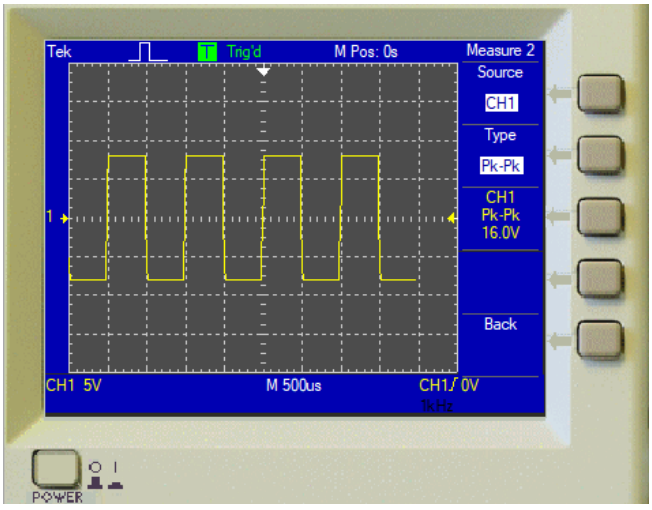


Figure 6 : Square Wave

b)

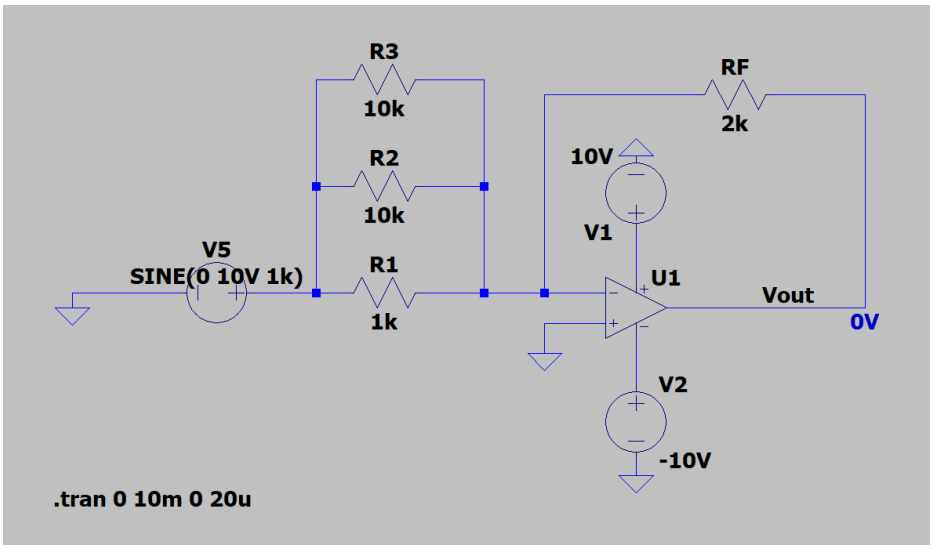


Figure 7 : Circuit for b)

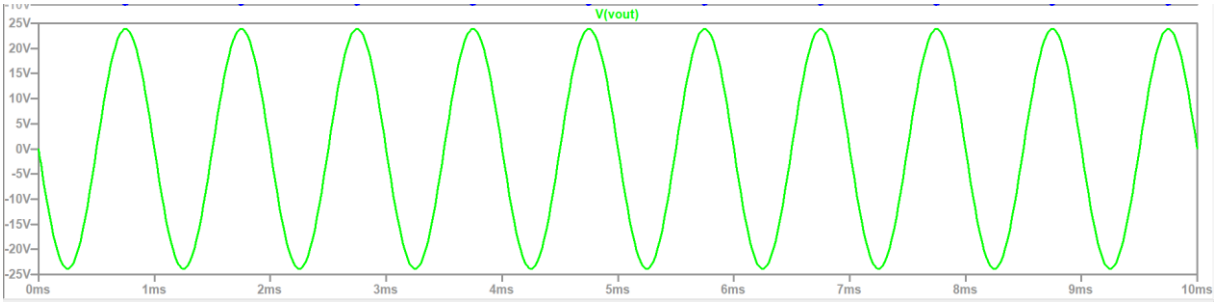


Figure 8 : Simulation for b)

2.1.1

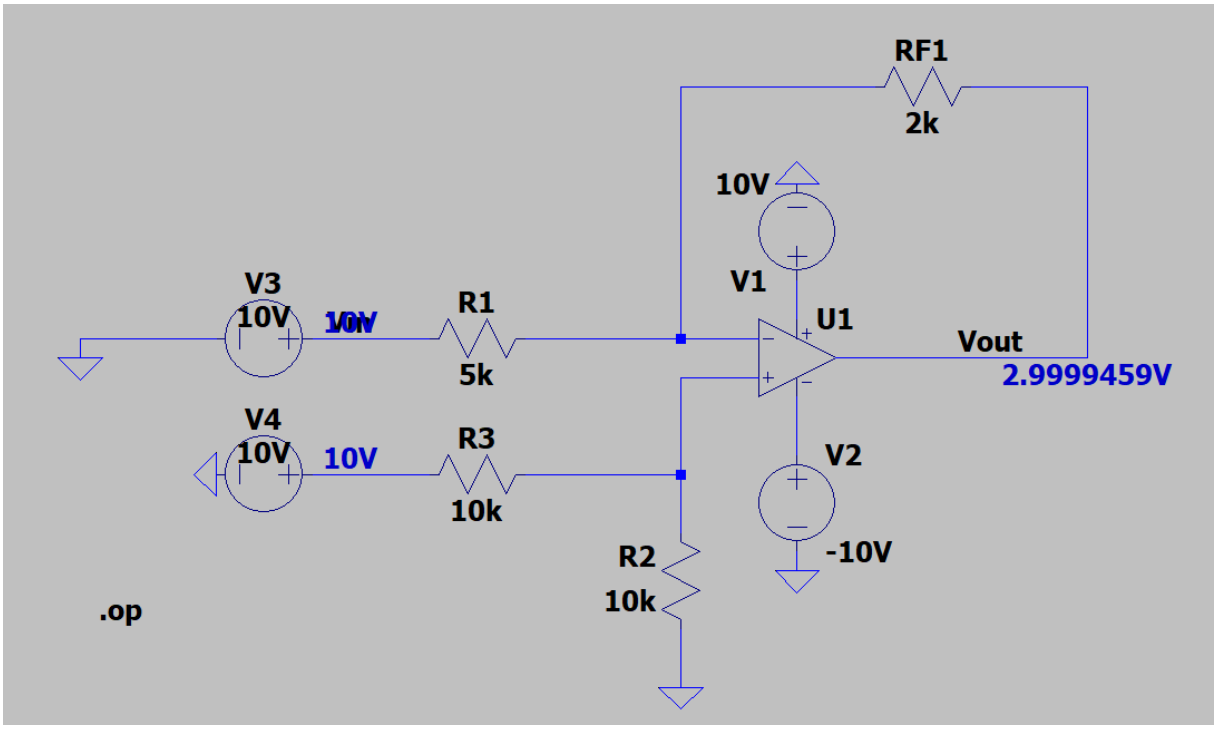


Figure 9 : Circuit for a)

b)

TABLE 1 :

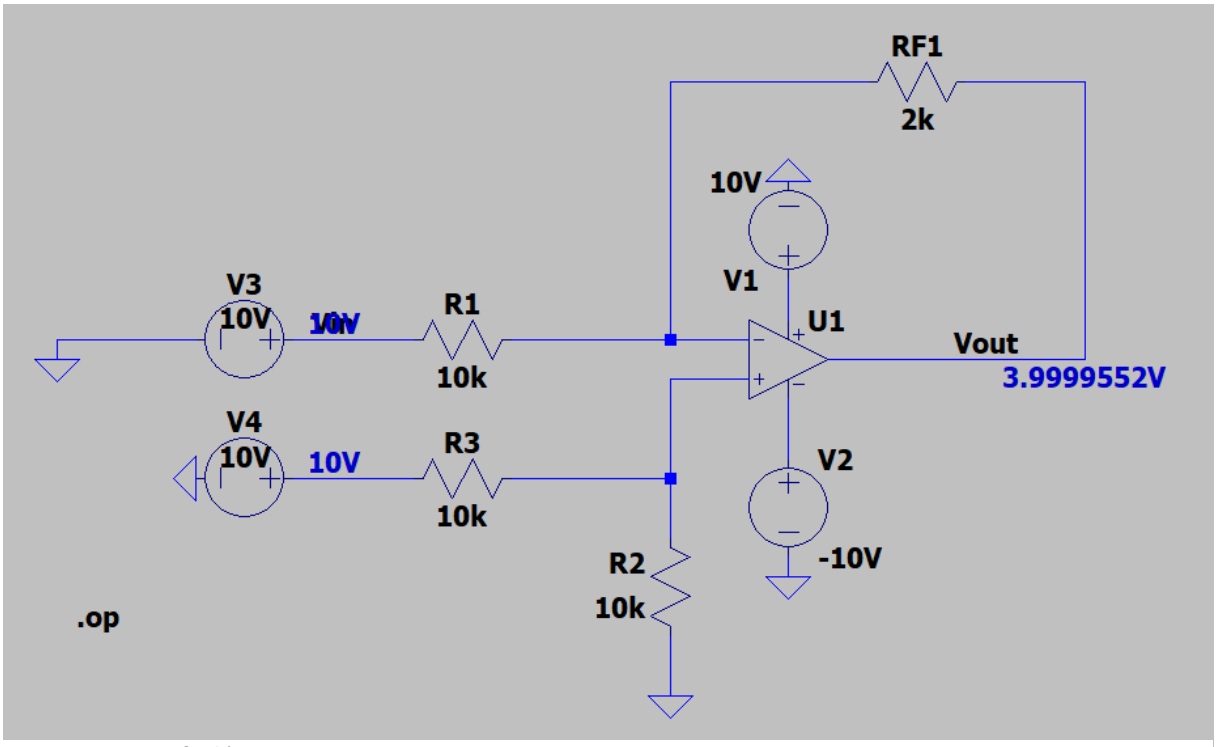


Figure 10 : Circuit for b)

TABLE2

	a)	b)
V_{out}	3V	4V
Gain	0.3	0.4

1.2.2

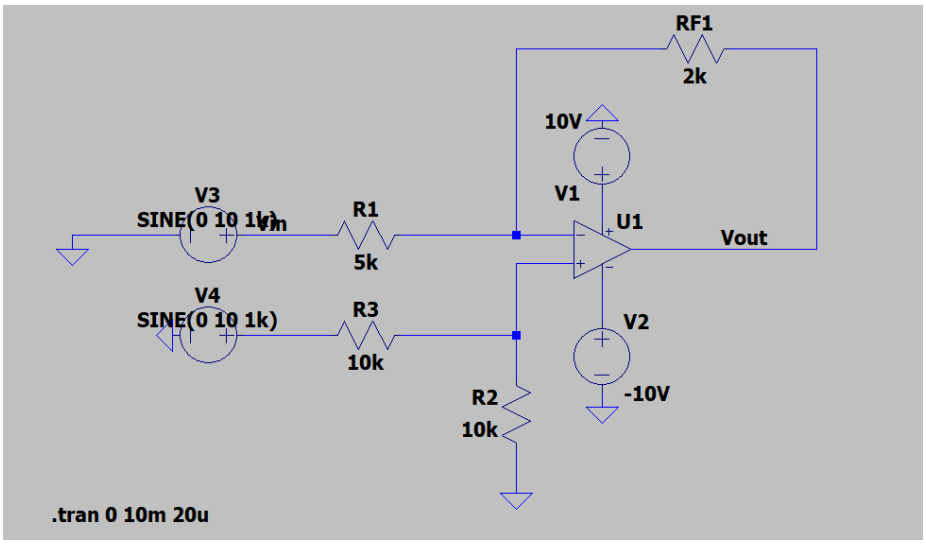


Figure 11 : Circuit for AC Voltage

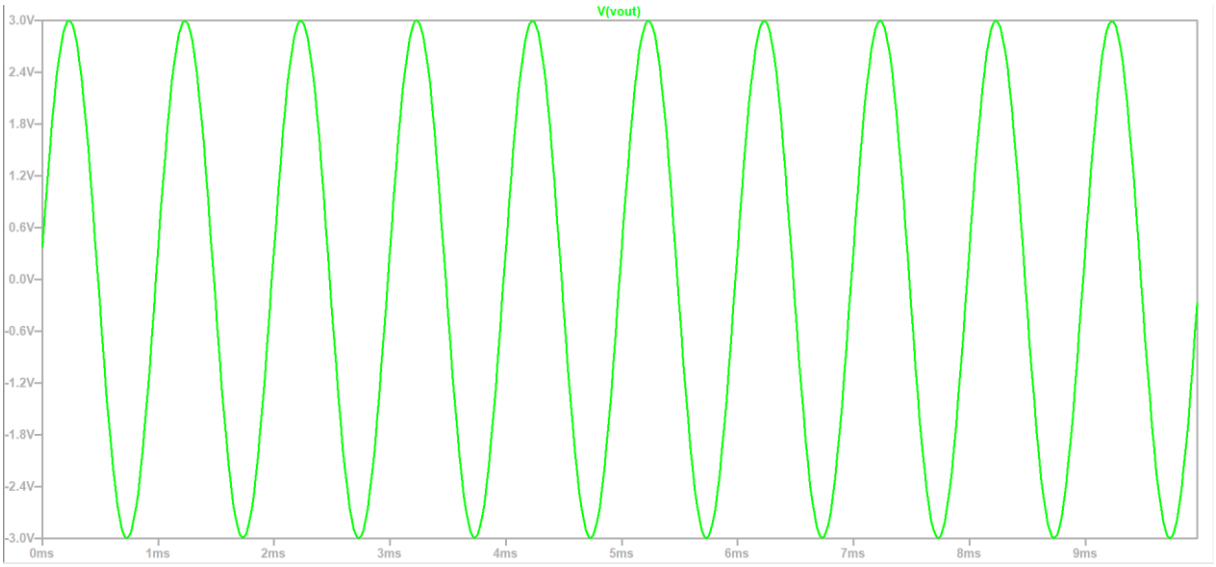


Figure 12 : Simulation Result

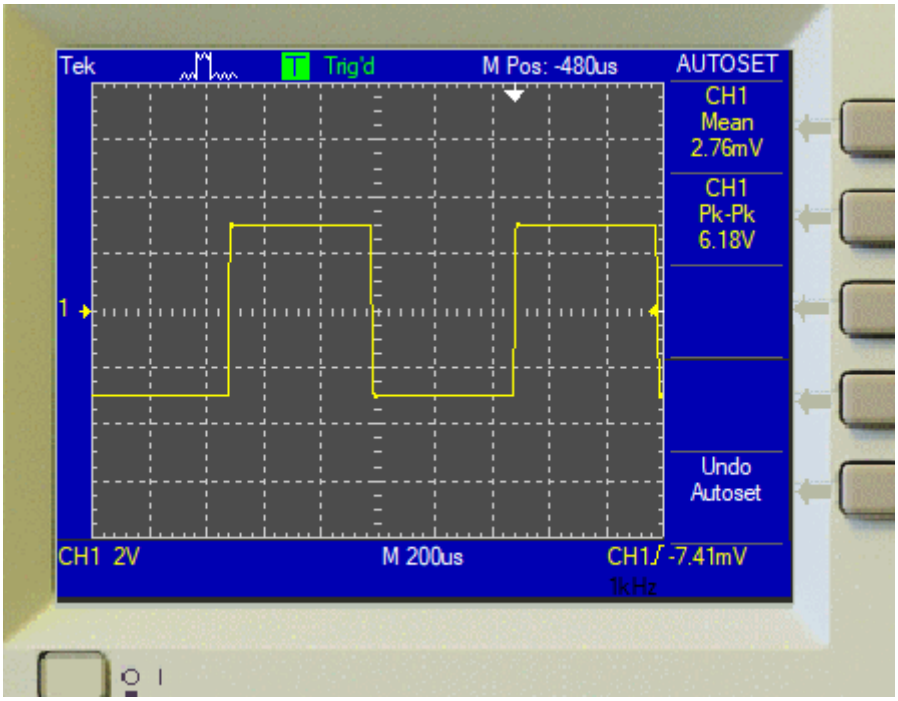
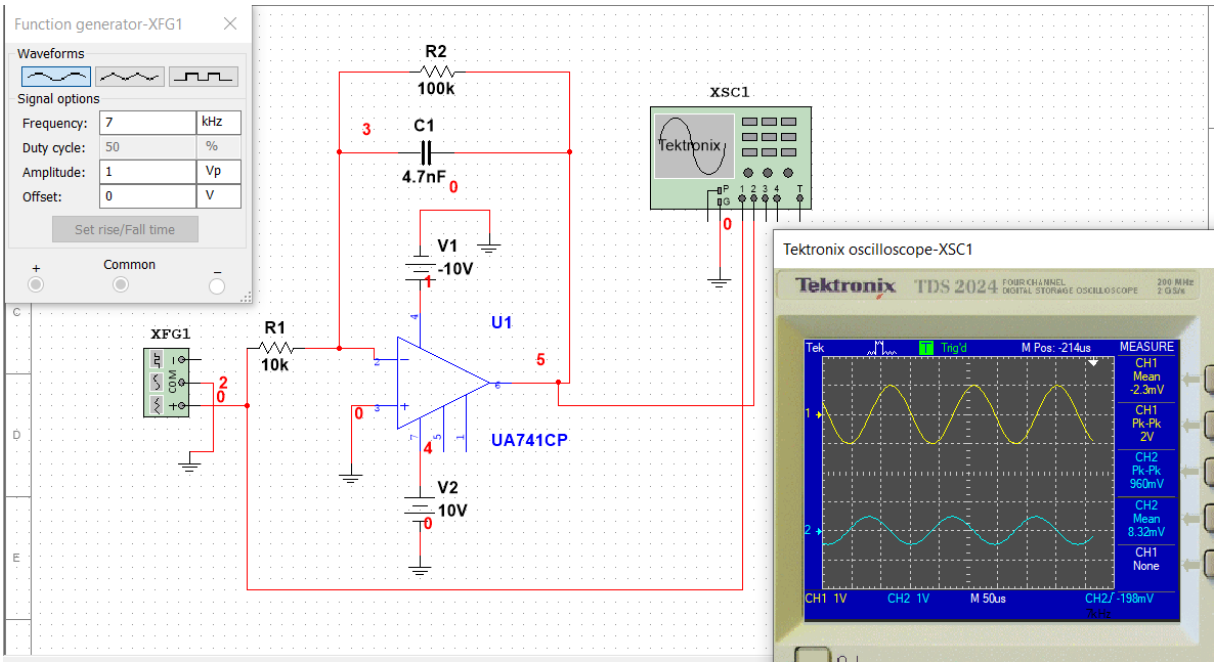


Figure 13 : Square Wave

2) INTEGRATOR CIRCUIT

2.1



GAIN: $A_{V=-}\frac{R_F}{R_1} = \frac{-100k}{10k} = -10$

$V_{in} = \sin(\, 2 \times \pi \times 7000\, t\,)$

$$V_{out} = \frac{-1}{R_1 \times C_F} \times \int \sin(\, 2 \times \pi \times 7000\, t\,)\, dt$$

$$V_{out} = \frac{-1}{10000 \times 4.7\ \times 10^{-9}} \times \int \sin(\, 2 \times \pi \times 7000\, t\,)\, dt$$

$= 0.048 \times \cos(2 \times \pi \times 7000\, t)$

COMMENT:

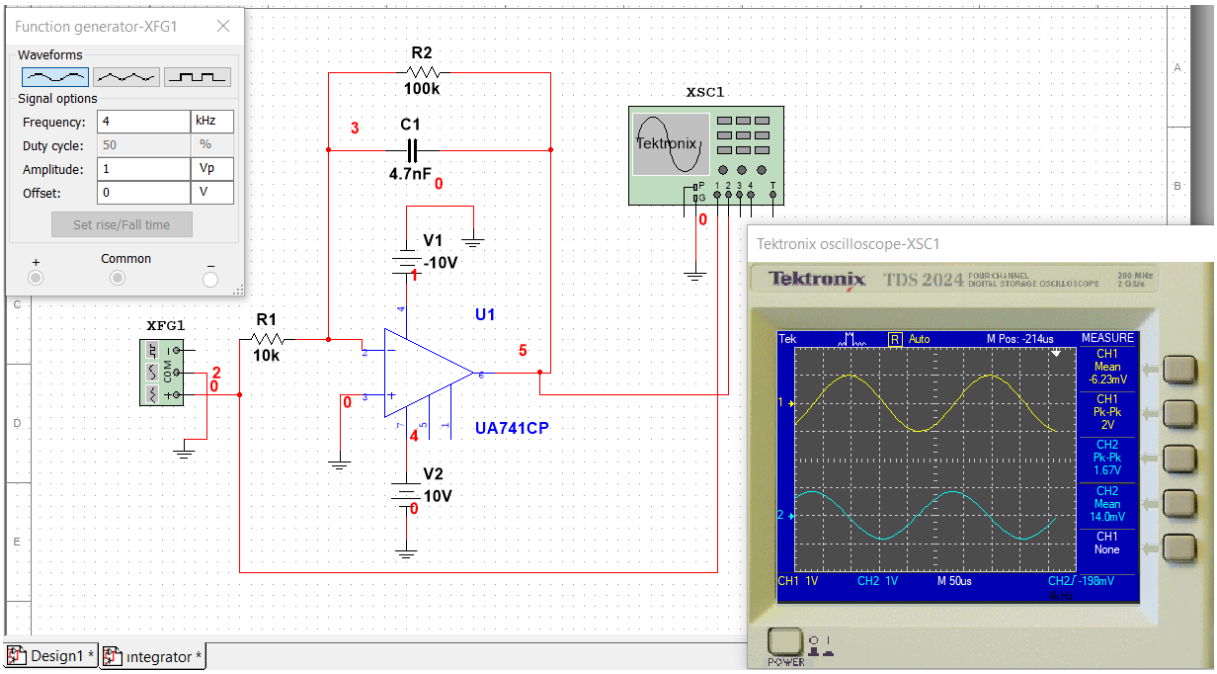
$$f_L = \frac{1}{2 \times \pi \times R_F \times C_F} = \frac{1}{2 \times \pi \times 100 \times 4.7 \times 10^{-9}} = 337\ Hz$$

$f_S > 10 f_L \rightarrow 10 \times 337 Hz = 3370\ Hz = 3.370\ kHz$

şartını sağlayan frekans değerleri kaynak frekansı olamalıdır ki devre integrator özelliği *gösterebilsin. Bu nedenle 7 kHz değeri bu şartı sağlar. Yani devre integrator gibi* çalışır.

2.2

4 kHz:



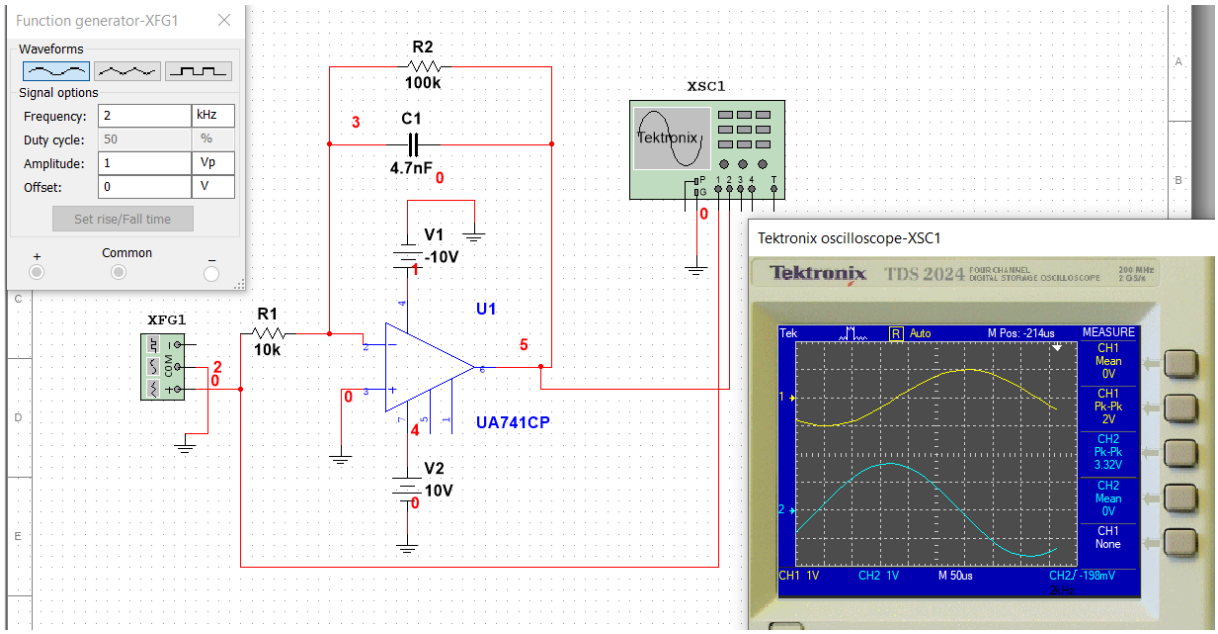
$$V_{in} = \sin(\,2 \times \pi \times 4000\; t\,)$$

$$V_{out} = \frac{-1}{R_1 \times C_F} \times \int \sin(\,2 \times \pi \times 4000\; t\,)\; dt$$

$$V_{out} = \frac{-1}{10000 \times 4.7\; \times 10^{-9}} \times \int \sin(\,2 \times \pi \times 4000\; t\,)\; dt$$

$$= 0.85 \times \cos\,(2 \times \pi \times 4000\; t)$$

2 kHz:



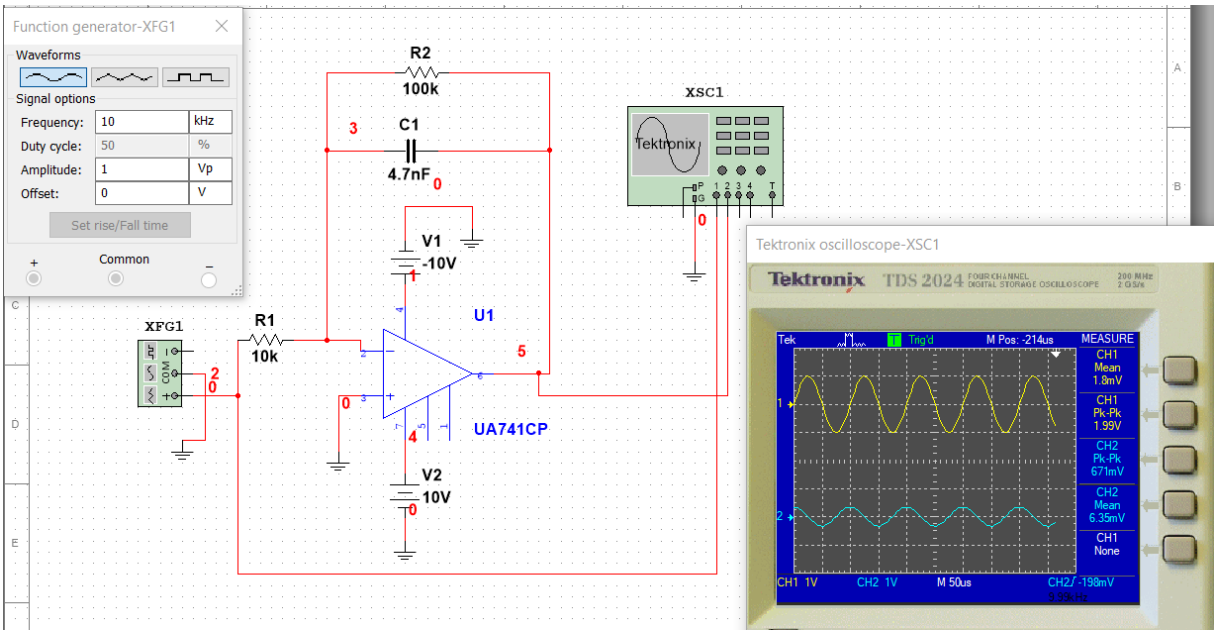
$$V_{in} = \sin(\,2 \times \pi \times 2000\; t\,)$$

$$V_{out} = \frac{-1}{R_1 \times C_F} \times \int \sin(\,2 \times \pi \times 2000\; t\,)\; dt$$

$$V_{out} = \frac{-1}{10000 \times 4.7\; \times 10^{-9}} \times \int \sin(\,2 \times \pi \times 4 - 2000\; t\,)\; dt$$

$$= 1.7 \times \cos\,(2 \times \pi \times 2000\; t)$$

10 kHz:



$V_{in} = \sin(\, 2 \times \pi \times 10000\, t\,)$

$V_{out} = \dfrac{-1}{R_1 \times C_F} \times \int \sin(\, 2 \times \pi \times 10000\, t\,)\, dt$

$V_{out} = \dfrac{-1}{10000 \times 4.7\ \times 10^{-9}} \times \int \sin(\, 2 \times \pi \times 10000\, t\,)\, dt$

= 0.34× cos $(2 \times \pi \times 10000\, t)$

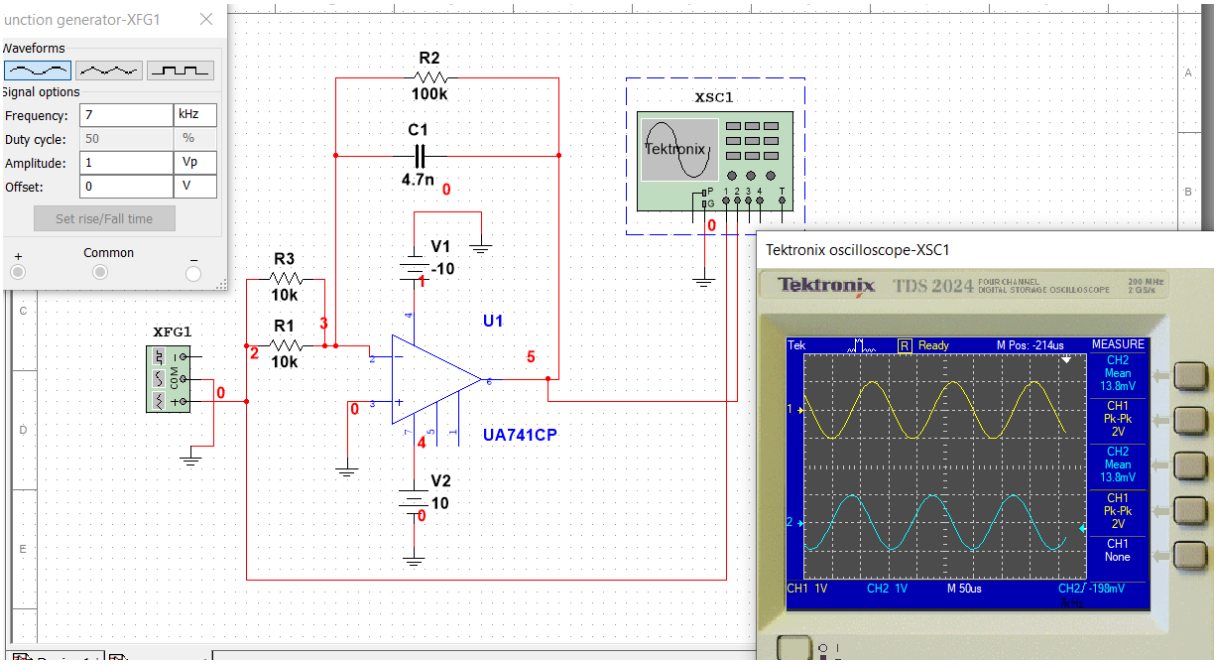
COMMENT:

$f_L = \dfrac{1}{2 \times \pi \times R_F \times C_F} = \dfrac{1}{2 \times \pi \times 100 \times 4.7 \times 10^{-9}} = 337\ Hz$

$f_S > 10 f_L \rightarrow 10 \times 337 Hz = 3370\ Hz = 3.370\ kHz$

şartını sağlayan frekans değerleri kaynak frekansı olamalıdır ki devre integrator özelliği *gösterebilsin. Bu nedenle* 4 *kHz,* 2 *khz ve* 10 *kHz frekans değerlerinden* 2 *kHz değeri bu şartı sağlamaz* .

2.3



$$V_{in} = \sin(2 \times \pi \times 7000\, t)$$

$$V_{out} = \frac{-1}{R_1 \times C_F} \times \int \sin(2 \times \pi \times 7000\, t)\, dt$$

$$V_{out} = \frac{-1}{5000 \times 4.7 \times 10^{-9}} \times \int \sin(2 \times \pi \times 7000\, t)\, dt$$

$$= 0.97 \times \cos (2 \times \pi \times 7000\, t)$$