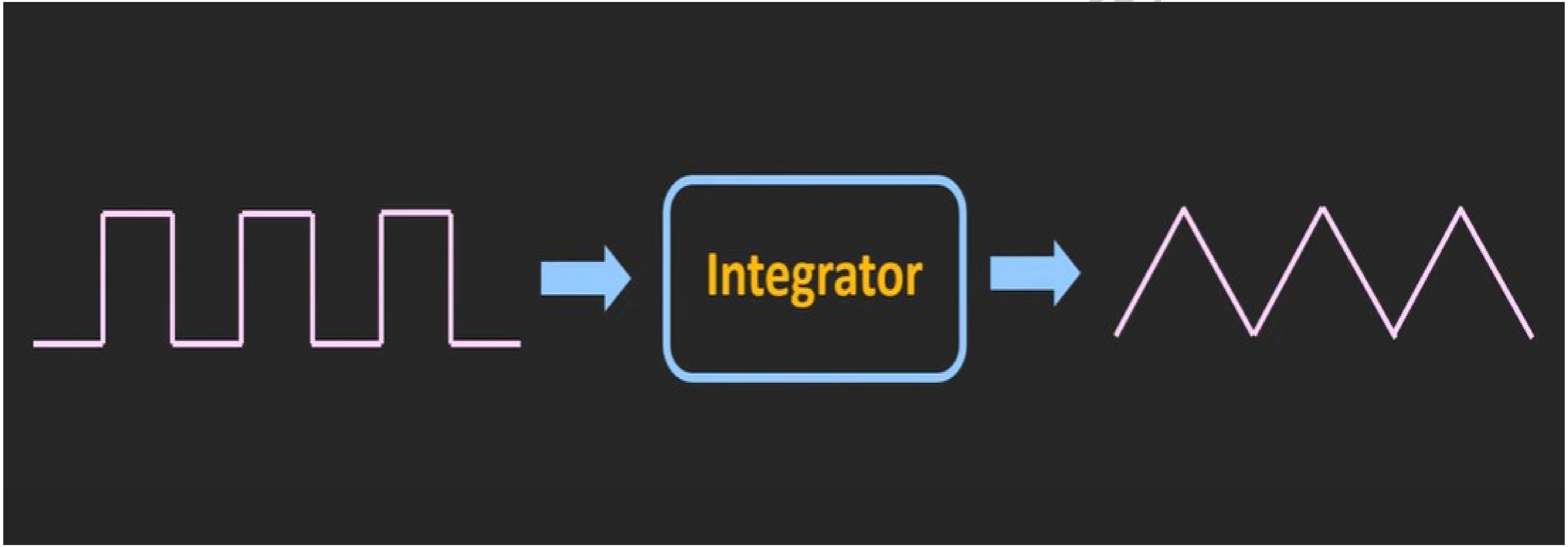
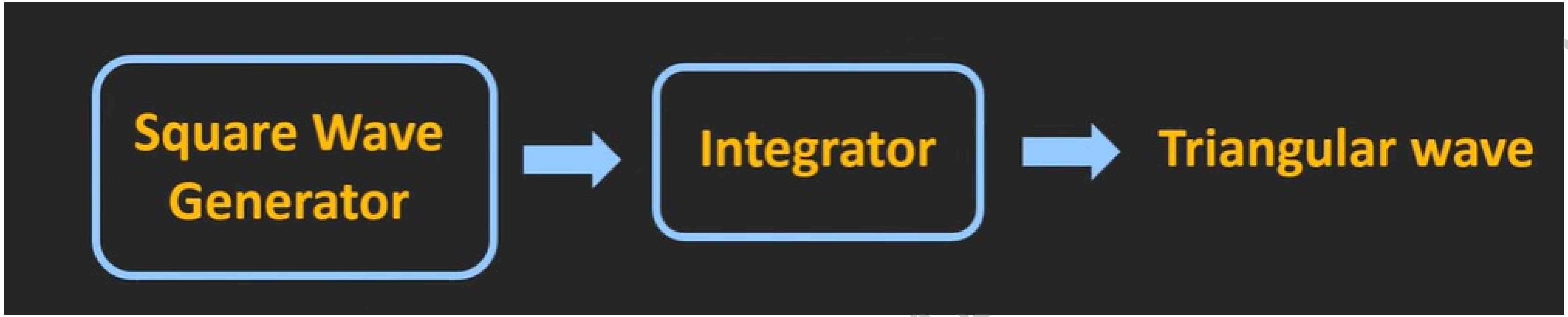
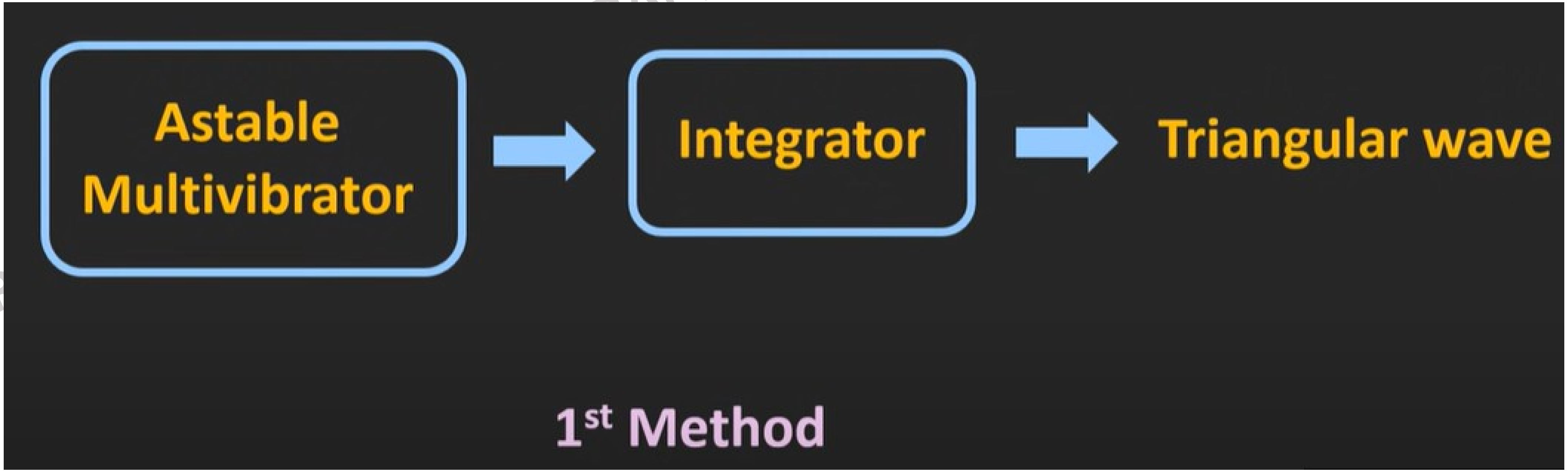
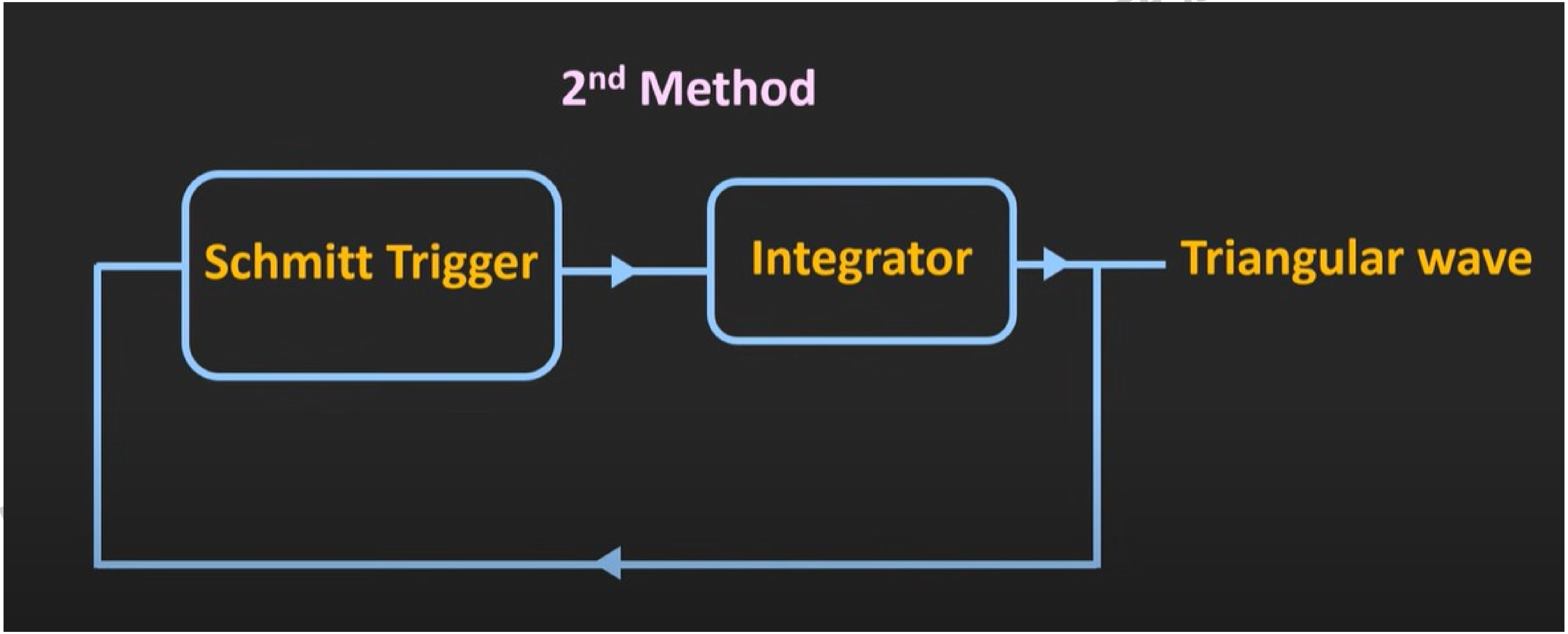
TRIANGULAR WAVE GENERATOR

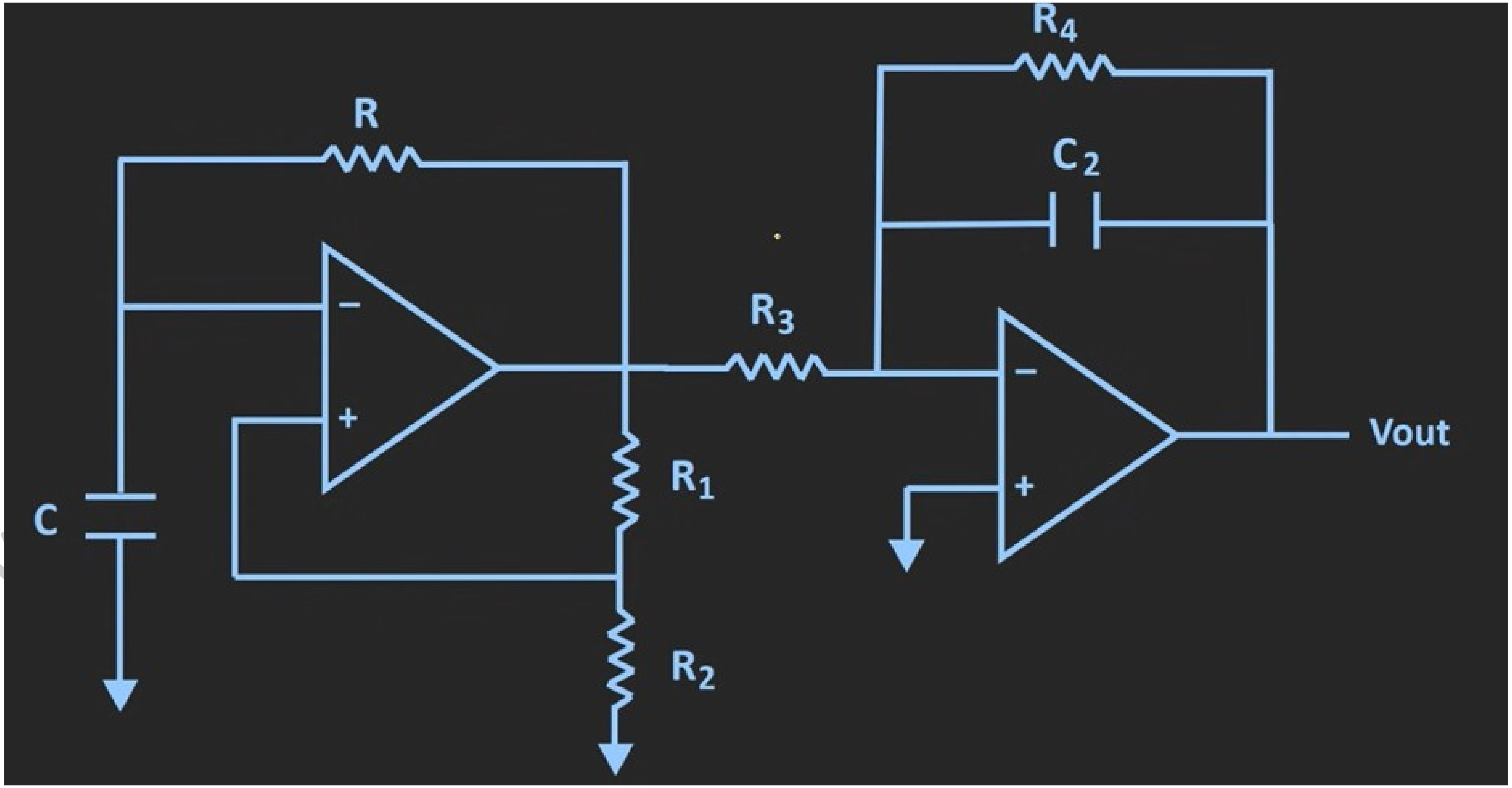


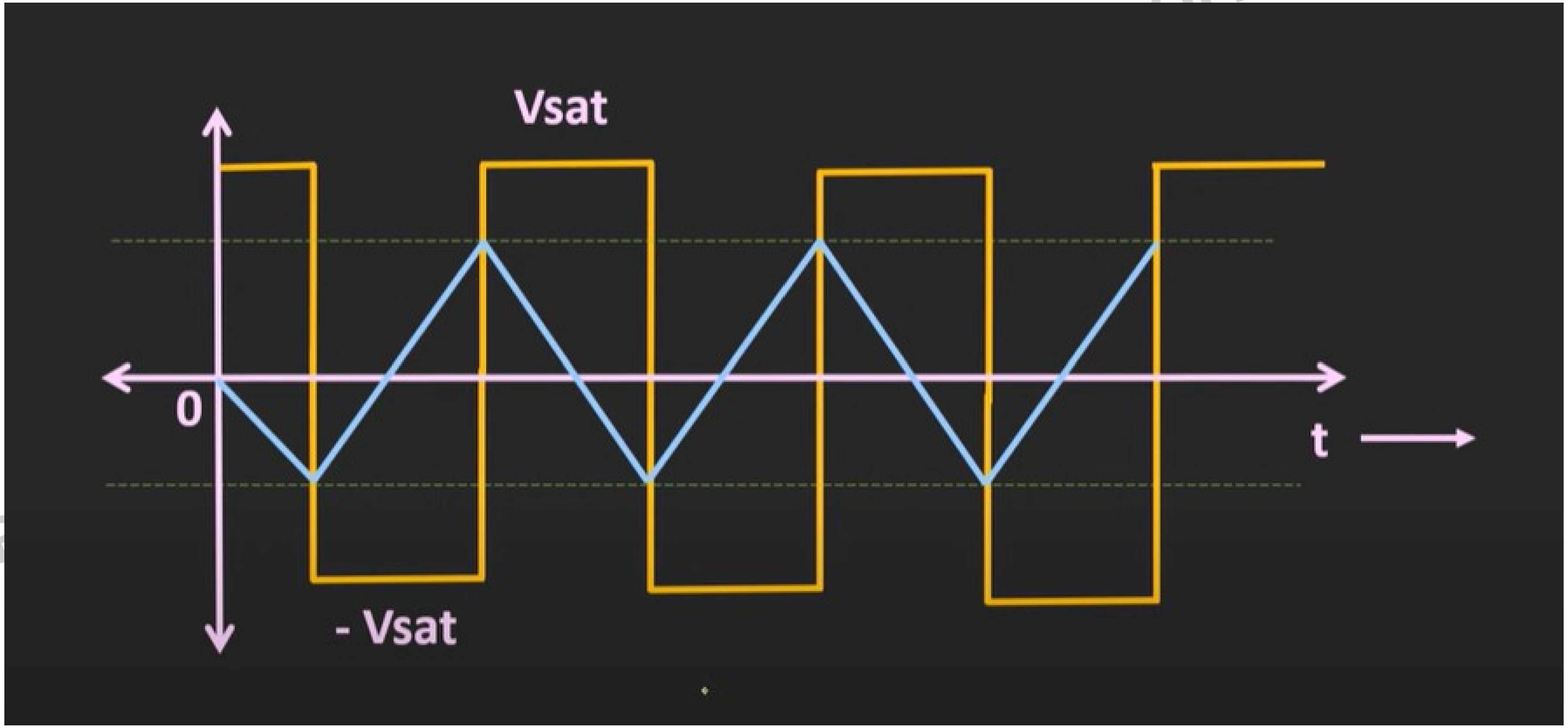

Square Wave Generator
Integrator
Triangular wave


Astable Multivibrator
Integrator
Triangular wave
1st Method


2nd Method
Schmitt Trigger
Integrator
Triangular wave

TRIANGULAR WAVE GENERATOR METHOD 1



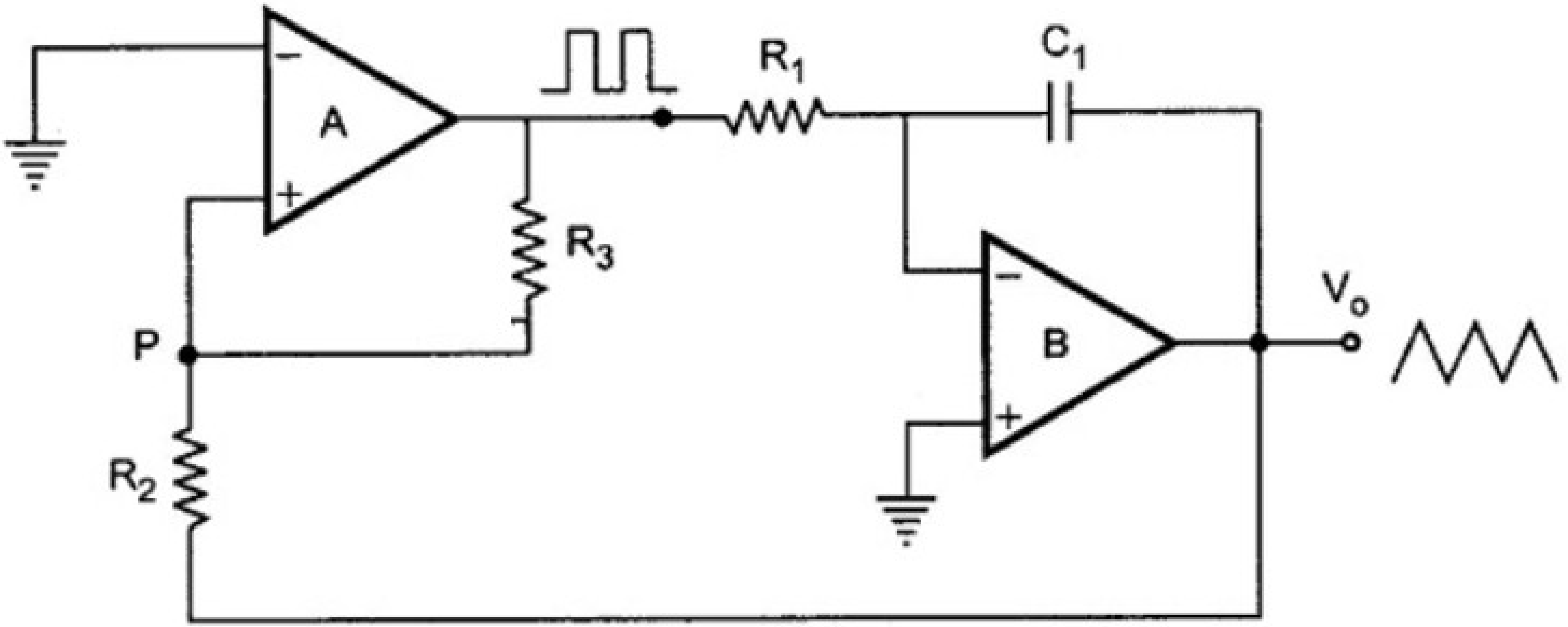

Vsat
0
t
- Vsat

- It is clear that freq of square & triangle wave is same.
- Amp of square wave is constant at $\pm V_{sat}$
- But the amp of triangle wave will decrease as freq increases.

It is bcoz of reactance of C_2 in f/b ckt decreases at high freqs.

- R_4 to avoid saturation problem at low freq (practical integratr).

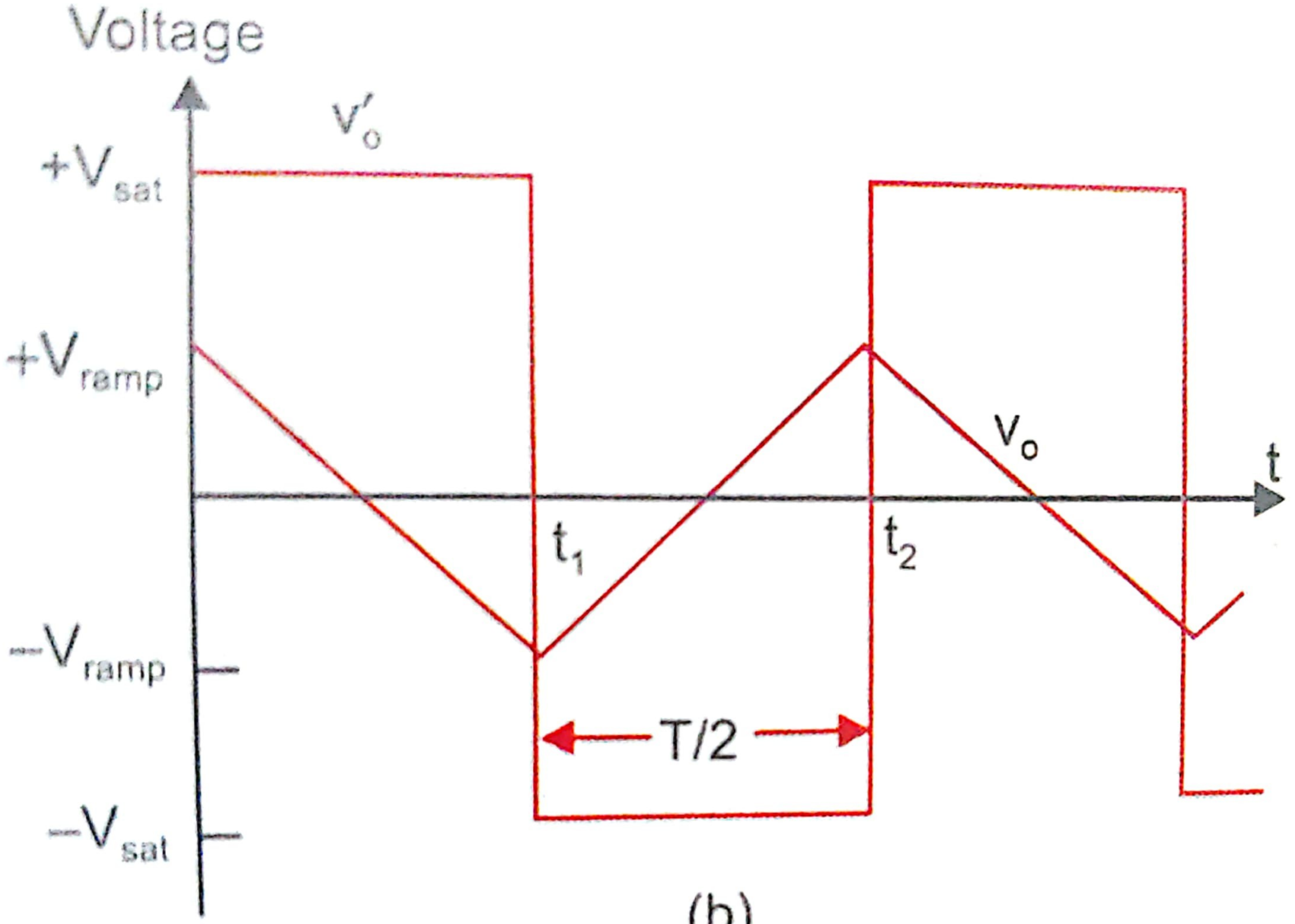
Triangular Wave Generator Using Lesser Components (Method 2)



- Consists of 2 level comparator (Schmitt Trigger) followed by an integrator.
- o/p of comparator A is a square wave of amp $\pm V_{sat}$
- This is applied to integrtr B producing triangle wave.
- This triangle wave is fed back as i/p to comparator A thru a V divider R2R3.
- Initially let o/p of A is at $+V_{sat}$.
- o/p of B will be a –ve going ramp .

- Initially R3 will be at the positive end of the A and it’s another end will be at the negative due to the B negative going Ramp.
- So one end of V divider R2R3 is at $+V_{sat}$ and other end at –ve going ramp.

- So at a certain point, the P will fall below the 0.
- Due to this the output of the square wave generator falls to the negative saturation voltage.



(b)

- At t=t1, when –ve gng ramp attains a value of $-V_{ramp}$, effective V at pt P becomes slightly less than 0.
- o/p of A switches to $-V_{sat.}$
- o/p of B starts increasing in +ve dir. +ve gng ramp.
- At t =t2, V at P becomes jz above 0.
- So o/p of A again $+V_{sat.}$
- cycle repeats and generates a triangle wave.
- Freq of both wave same.
- But amp of triangle wave depends on RC value of integrator and o/p of A.

Calculation of freq of triangle wave:

Effective V at P when o/p of A is +Vsat

$$= V_{sat} \quad + -V_{ramp}$$

- At t=t1, V at pt P =0

$$V_{sat} \quad + -V_{ramp} \quad = 0$$

$$R_2\ V_{sat} = R_3\ V_{ramp}$$

$$\mathbf{-V_{ramp} = -\ (+V_{sat})}$$

- At t=t2, when o/p switches from $-V_{sat}$ to $+V_{sat}$

$+V_{ramp} = -(-V_{sat})$

$$+V_{ramp} = (V_{sat})$$

Peak to peak amp of tri wave

$V_0(pp) = +V_{ramp} - (-V_{ramp})$

$$V_0(pp) = (V_{sat})$$

- o/p switches from $-V_{ramp}$ to $+V_{ramp}$ in half the time period T/2.
- Putting the values in basic integrator eqn

$V_0 = -$ dt

$V_0(pp) = -$

$V_0(pp) =$

$T = 2R_1C_1$

We have $V_0(pp) = (V_{sat})$

$T = 4R_1C_1$

- Freq of oscn $f_0 =$

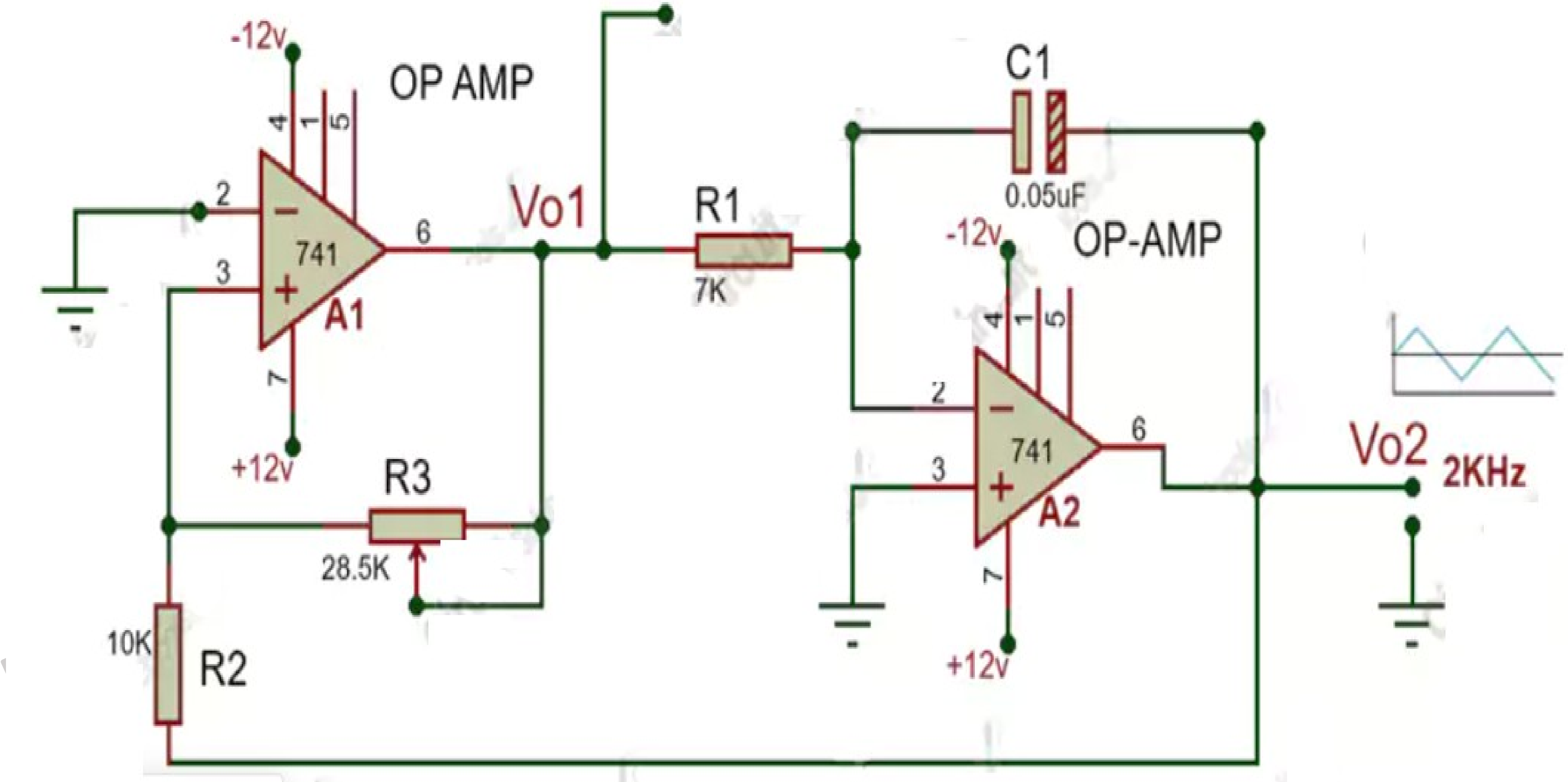
Q: design a 2KHz Triangular wave generator circuit

Hint:

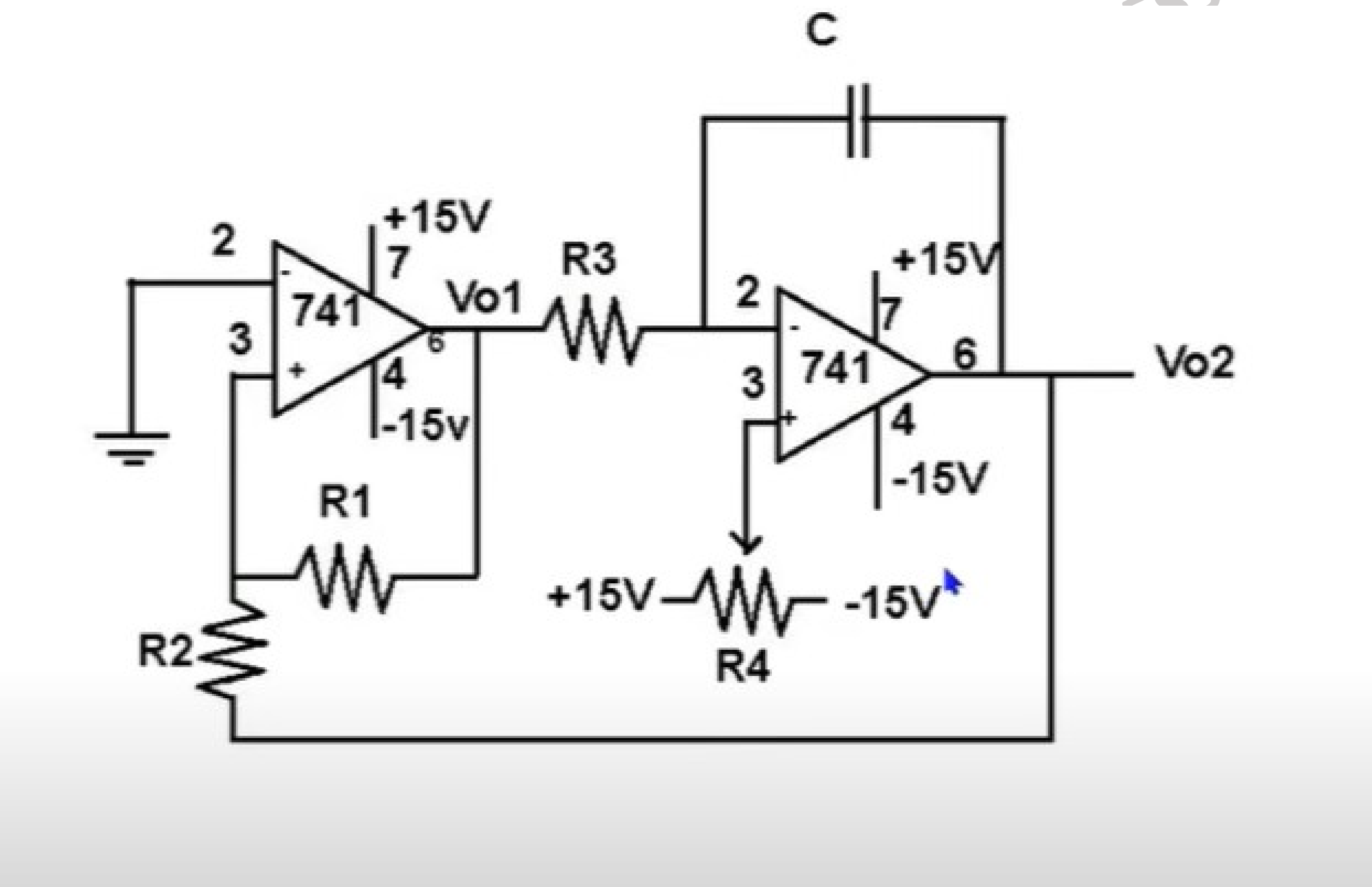
- Consider **Op-Amp IC741** with supply voltage ±12v. Lets expect output peak to peak voltage to be 7 volts.
- Assume R2= 10K ohm, Capacitor C= 0.05µF

Ans:

- R3 = 28.5Kohm
- R1=7 Kohm
- We can use a varistor/potentiometer of 50k ohm to get the R3 as 28.5Kohm.
- Draw the ckt with designed values.


-12v
OP AMP
4
1
5
2
3
741
A1
6
7
+12v
Vo1
R1
7K
C1
0.05uF
-12v
OP-AMP
741
A2
+12v
Vo2
2KHz
R3
28.5K
10K
R2

SAWTOOTH WAVEFORM GENERATOR



- The sawtooth wave generator is one kind of linear, non-sinusoidal waveform, and the shape of this waveform is a triangular shape in which the fall time and rise time are different.
- The sawtooth waveform can also be named an asymmetric triangular wave.
- The triangular wave generator can be converted in to a sawtooth wave generator by injecting a variable dc voltage into the non-inverting terminal of the integrator.
- A potentiometer is used in this ckt.

- Now the output of integrator is a triangular wave riding on some dc level that is a function of R4 setting.
- The duty cycle of square wave will be determined by the polarity and amplitude of dc level.
- A duty cycle less than 50% will cause output of integrator be a sawtooth.
- With the wiper at the centre of R4, the output of integrator is a triangular wave.
- Use of the potentiometer is when the wiper moves towards $-V_{EE}$ and $+V_{CC}$.

- When the wiper moves toward negative voltage(-V); then the rise time becomes more than the fall time.
- When the wiper moves towards positive voltage(+V), then the rise time becomes less than the fall time.

- Freq of sawtooth wave decreases as R_4 is adjusted towards $+V_{cc}$ or $-V_{EE}$.
- However amp of sawtooth is independent of R_4 settings.

Fig: Output of sawtooth wave generator when noninverting of integrator is at some negative dc level.