# Assignment - 04


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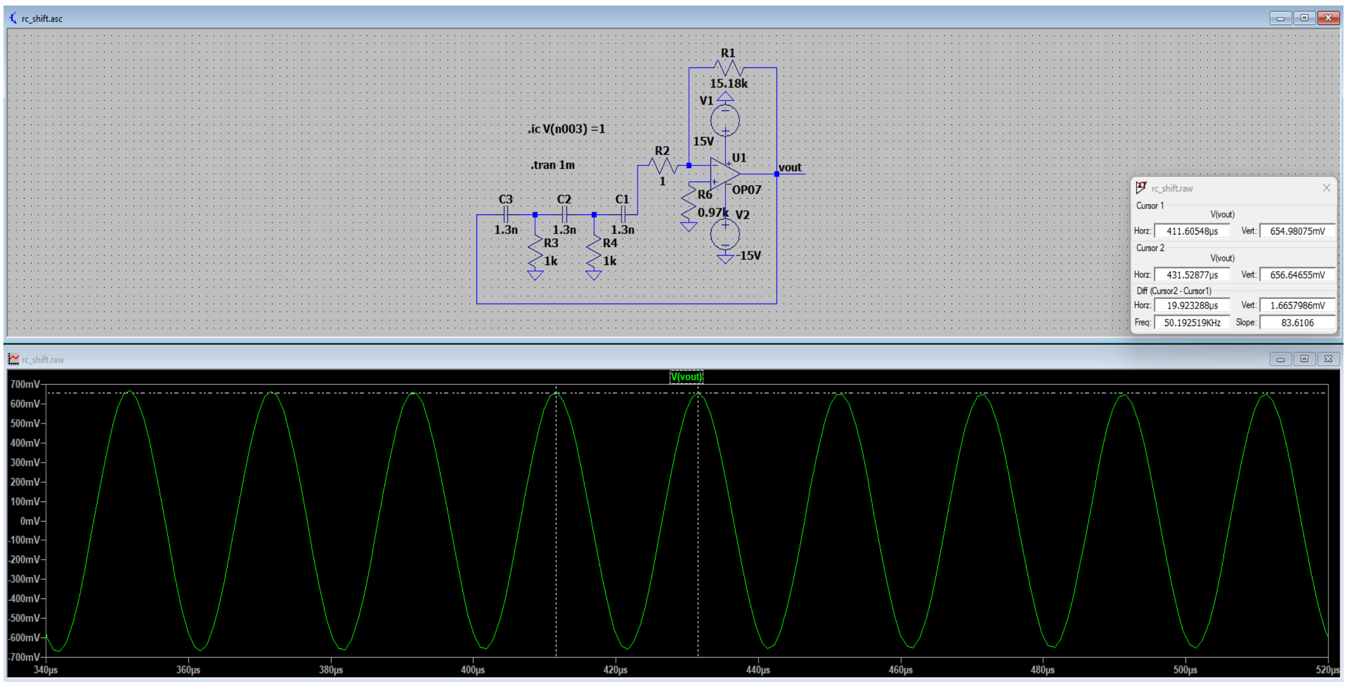
EE22BTECH11025


Q.a) A RC phase shift oscillator (3 stage) for 50 kHz sin wave signal output.

Solution:




We have a phase-shift oscillator in the given circuit with three lead circuits providing a 180° phase shift. The amplifier (op-amp) also introduces another 180° phase shift because the signal is applied to the inverting terminal. This cumulative phase shift around the loop totals 360°

For oscillations to start, the loop gain (Aβ) = 1 at a particular frequency.

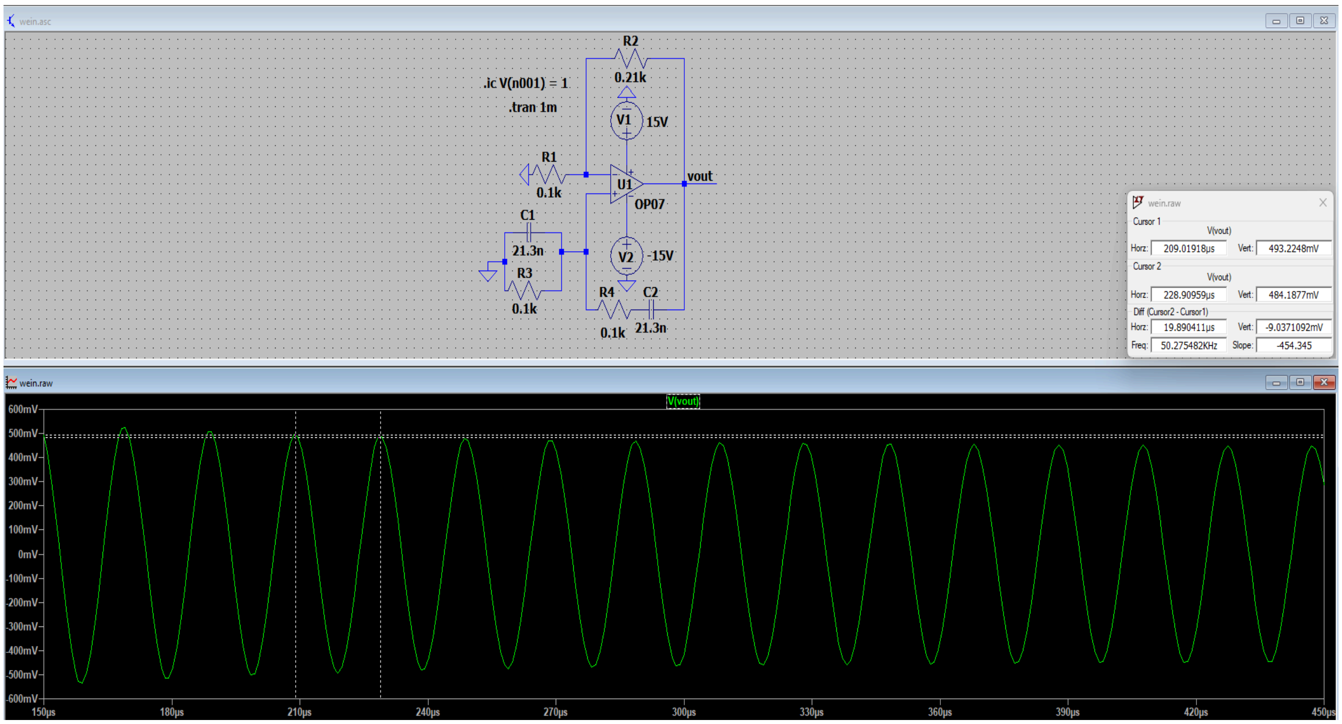
Also, $f = \frac{1}{2*\pi RC\sqrt{6}}$ and R1/R2 = 29 (ideally)

But, since I used a very low offset voltage op-amp(op07), I had to give a very high gain to amplify even the smallest input signals effectively, compensating for the minimal offset voltage of the op-amp.

Thus, got the above frequency of 50.12KHz for my sine wave.

## Q.b)A Wien bridge oscillator for 50 kHz sin wave signal output.

Solution:




The circuit shown is a Wein-Bridge Oscillator, which functions as a notch filter, cancelling out the output at one particular frequency. At first, A*β is greater than 1 to start oscillations; then, it settles at Aβ = 1 for ongoing oscillation.

Also, $f = \frac{1}{2*\pi RC}$ and R1/R2 = 2 (ideally)

Again, I had to keep a very high gain for the same reason as in (Qa).

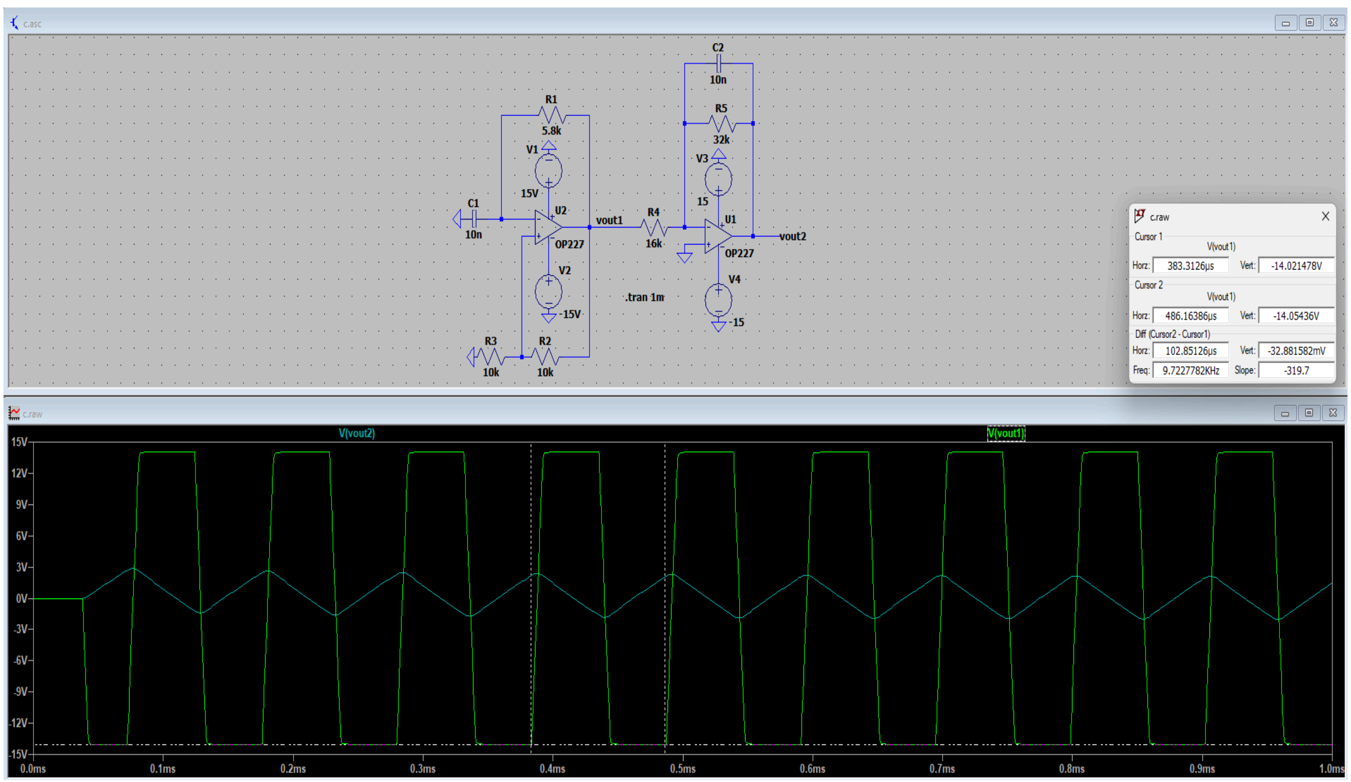
Simulated Frequency = 50.27KHz

**NOTE: Because I used an ultralow off-set voltage op-amp (OP07), my op-amps have a slower slew rate, leading to complications at high-frequency applications like 10KHz square wave generation.**

**From this point forward, I have used OP227, a better option for these applications.**

(Q.c) A Square wave generator for a fundamental frequency of 10 kHz signal output. Use an integrator and convert the square wave signal into a triangular wave.

Solution:



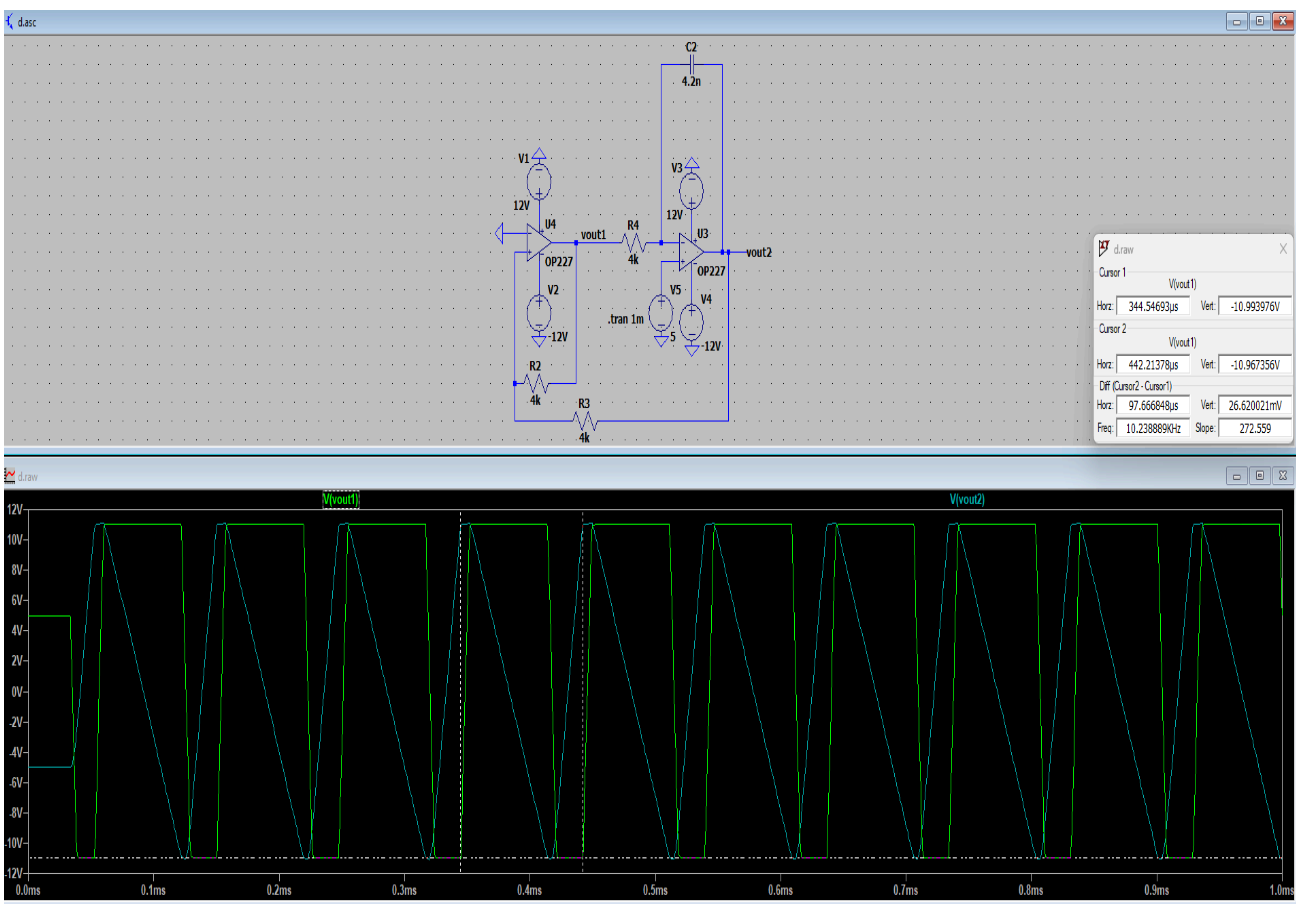
In the above astable multivibrator circuit, when the output voltage (Vout1) equals the voltage at the positive input terminal (V+), it signifies that V+ is greater than the voltage at the negative input terminal (V-) of the op-amp U2. As the capacitor charges, the voltage at V- starts to increase.

$$t1 = RC.\ln(1 + 2R3/R2) = t2$$

The output from the astable multivibrator undergoes integration in a circuit. In situations where the input remains steady, the output will be a ramp waveform exhibiting a 180° phase shift.

## (Q.d) A Square wave generator for a fundamental frequency of 10 kHz signal output. Use an integrator and convert the square wave signal a sawtooth wave with rise time = 1/2 fall time.

Solution:

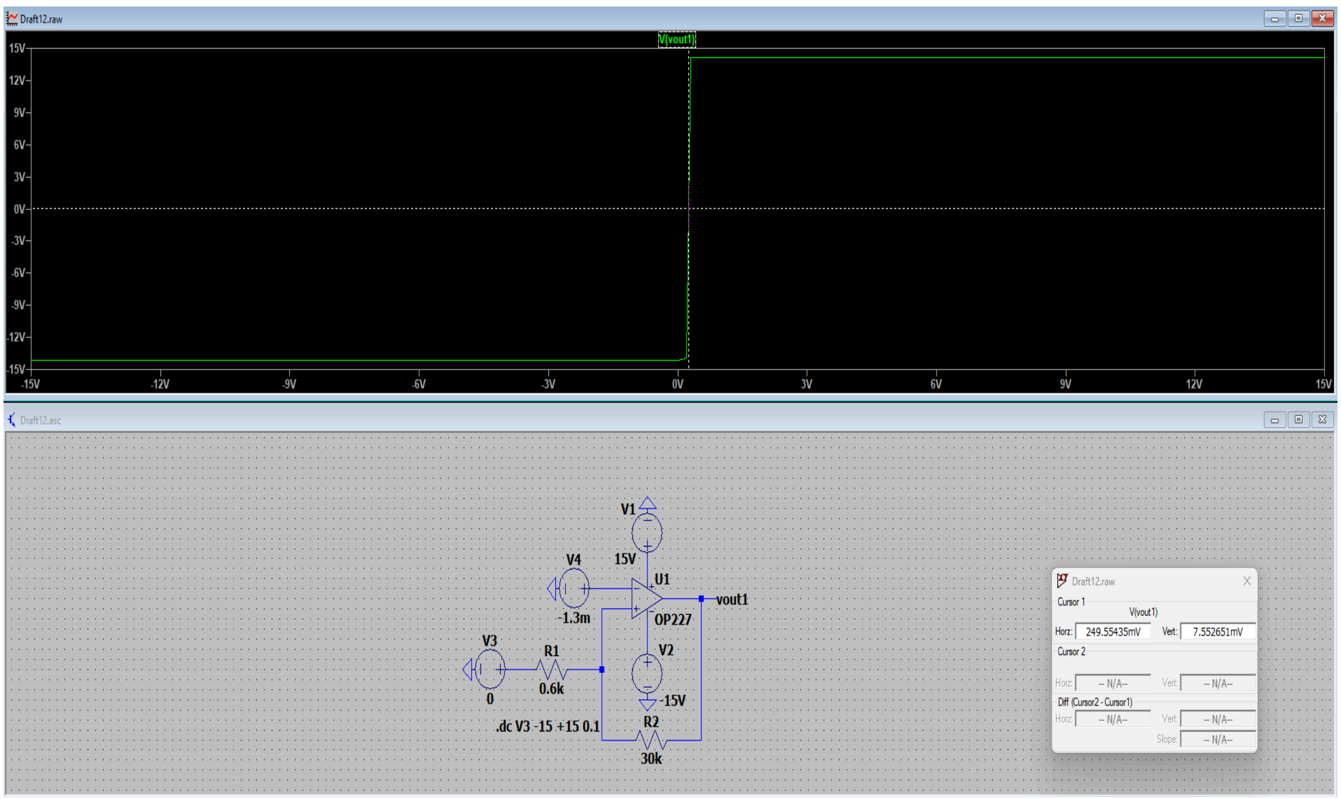


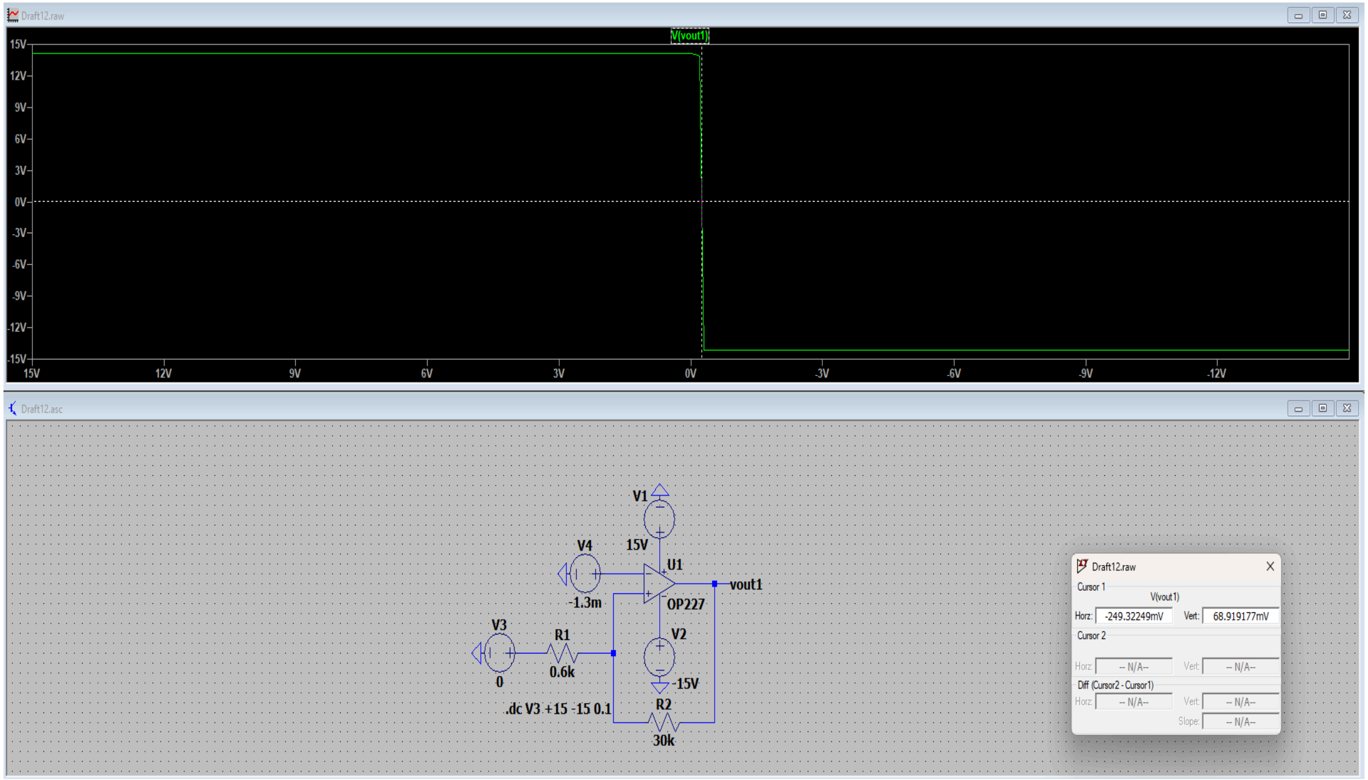
The circuit consists of two main sections: a comparator circuit in the first half and an integrator circuit in the second half. In this configuration, the final output wave exhibits a 180° phase difference compared to the input wave of the integrator circuit because the input wave is applied to the inverting terminal.

$$T = 4 * (R4 * C2)(R3/R2)$$

## (Q.e) Design a Schmitt trigger circuit and show the hysteresis curve with Vth (+ and -ve ) = +- 250mV

Solution:






A DC-sweep on the circuit's input voltage can be used to determine the op-amp's upper and lower threshold voltages.