East West University

Department of CSE

LAB REPORT

Course Code and Name: CSE251[Electronic Circuits]		
Project no: 01		
Design of a Triangular wave generator using Operational Amplifier for a specified input.		
Semester and Year: Fall-24	**GROUP NO: 02**	
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Date of Report Submitted: 25 January 2025	**TOTAL Marks:**	

Objective:

This project report focuses on the design and implementation of a triangular wave generator using operational amplifiers (op-amps). The triangular wave generator is a versatile circuit widely used in signal processing, function generators, and waveform synthesis. This report covers the theoretical background, circuit design, simulation, and experimental results for generating a triangular waveform based on a specified input frequency and amplitude.

Problem Statement:

Triangular wave generator circuit. The design process includes two design segments (a square wave generator & a triangular wave generator) to get the final output Vo (V). Use a $10V$pp sinusoid as input and operational amplifiers to the design. Design the circuit components, implement and finally test the circuit. [Note: Make sure the resistors in your design have values that do not exceed 10 kΩ.] Finally, implement the circuit, test it, and verify the output.

Equipment and Components:

1. 741 Op Amp
2. AC and DC Voltage Sources
3. Resistors
4. Capacitors

From the given square wave and the triangular wave, Time period, T = 4ms

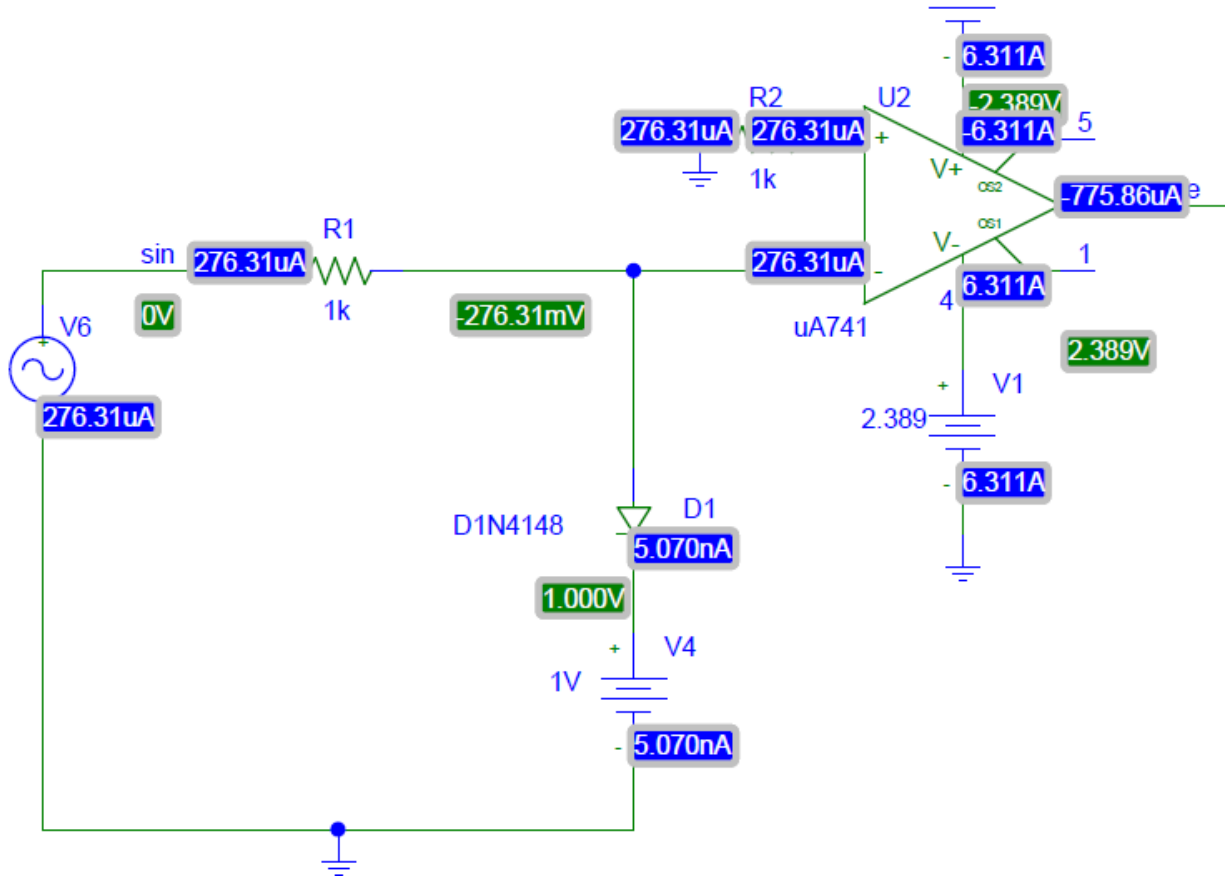
So, frequency of sine wave,

$$f = \frac{1}{T} = \frac{1}{4 \times 10^{-3}} Hz \quad = 250\ Hz$$

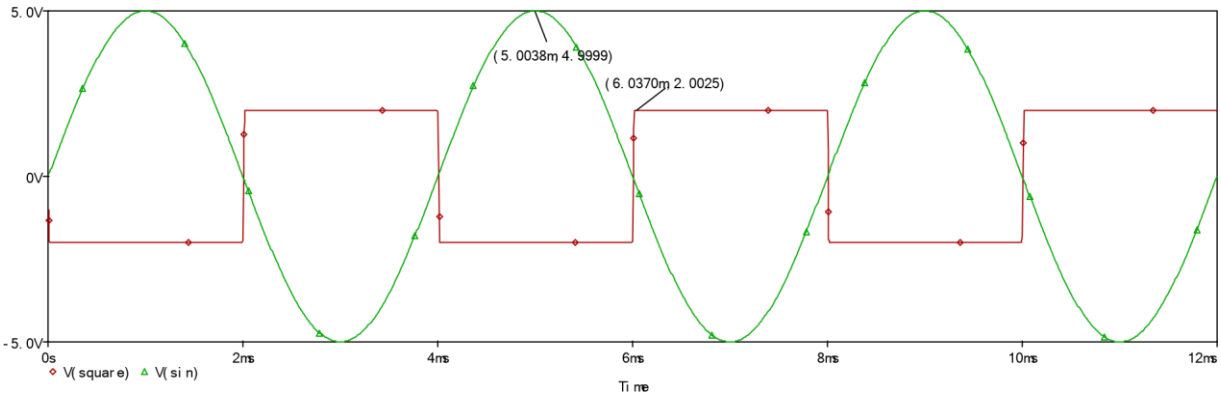
Generating Square wave:

Here is a sin wave of peak to peak 10V and frequency 250Hz and it goes through a positive biased clipper and then goes through a comparator circuit to generate a square wave of peak to peak 4V.

Circuit diagram of Square wave generator:

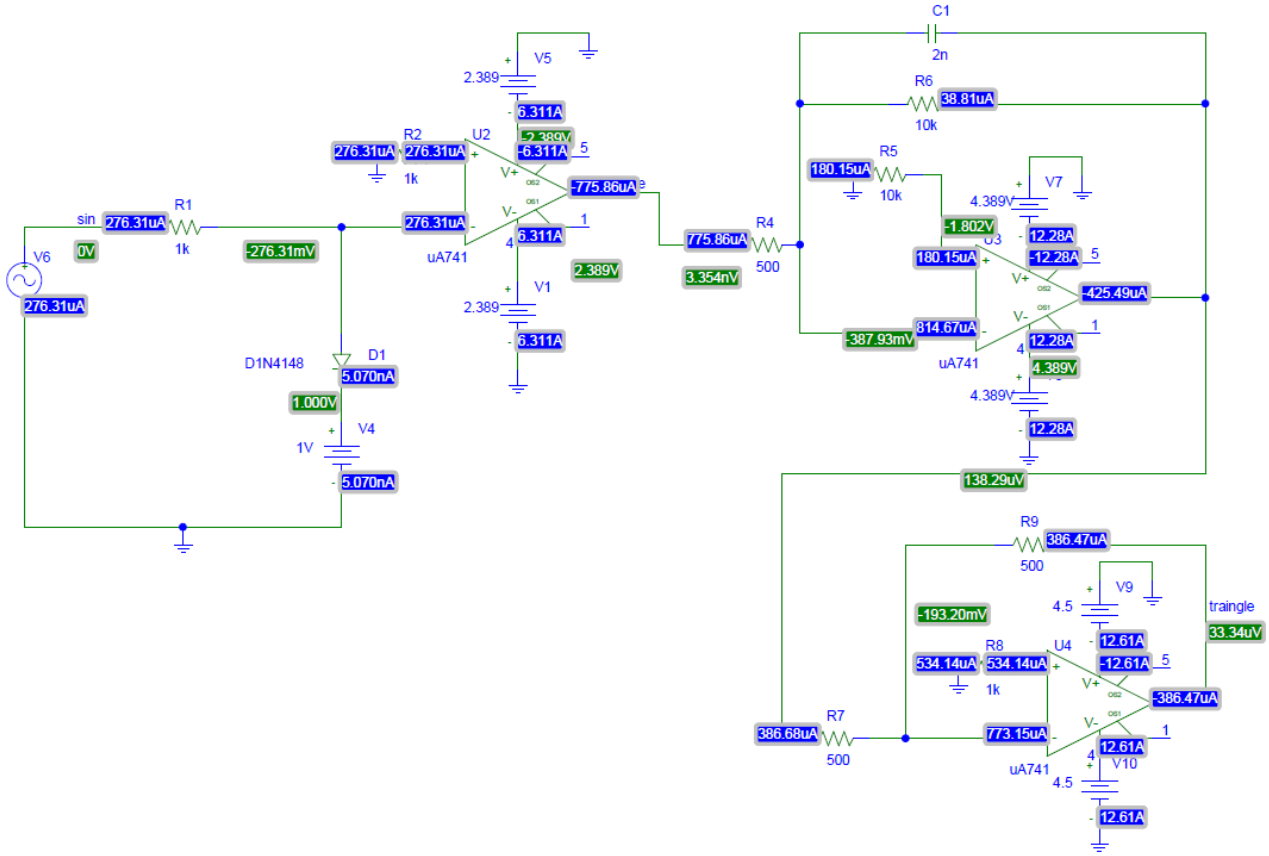


Simulation Result:

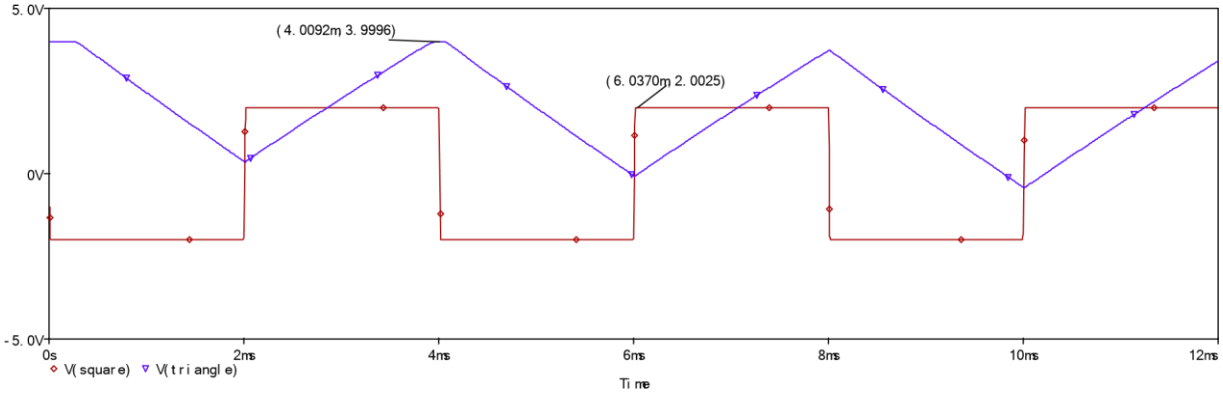


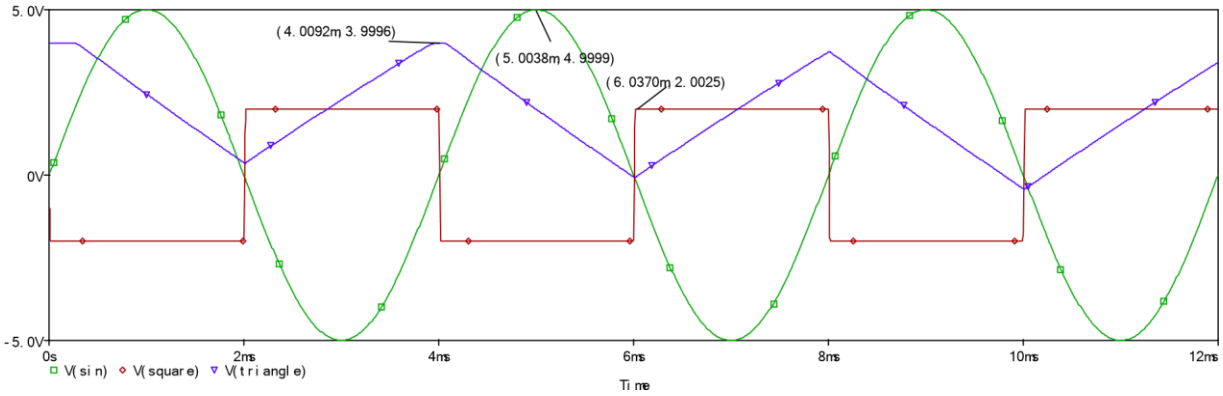
Generating Triangular wave:

To generate a triangular wave, we can use an **Op-amp Integrator Circuit**. This circuit takes a square wave as input and integrates it to produce a triangular wave. However, to avoid saturation of the output voltage and provide better control over the gain, a high-value resistor is added in parallel with the feedback capacitor C_1. This ensures the circuit works efficiently. The resulting output from the integrator will be a triangular wave, but it will be an inverted version, ranging from 0V to −4V. Since we need the triangular wave to range from 0V to +4V, we can pass this inverted triangular wave through an **Inverting Op-amp Circuit**. The inverting amplifier flips the waveform, giving us the desired triangular wave output with the range of 0V to +4V. This process ensures we obtain the triangular wave we need.



Simulation Result:





Conclusion:

This project successfully designed, simulated, and implemented a triangular wave generator using operational amplifiers. The circuit met the specified input requirements for frequency and amplitude. Minor deviations in the experimental results were within acceptable limits and attributed to component tolerances. This project demonstrates the effectiveness of op-amp-based circuits in waveform generation and their relevance in various applications. The resistance and capacitance values can be used to compute the frequency of the triangle wave. OP Amp 741 is used to generate the square and triangular waves, and PSpice is used to simulate the output waveforms.