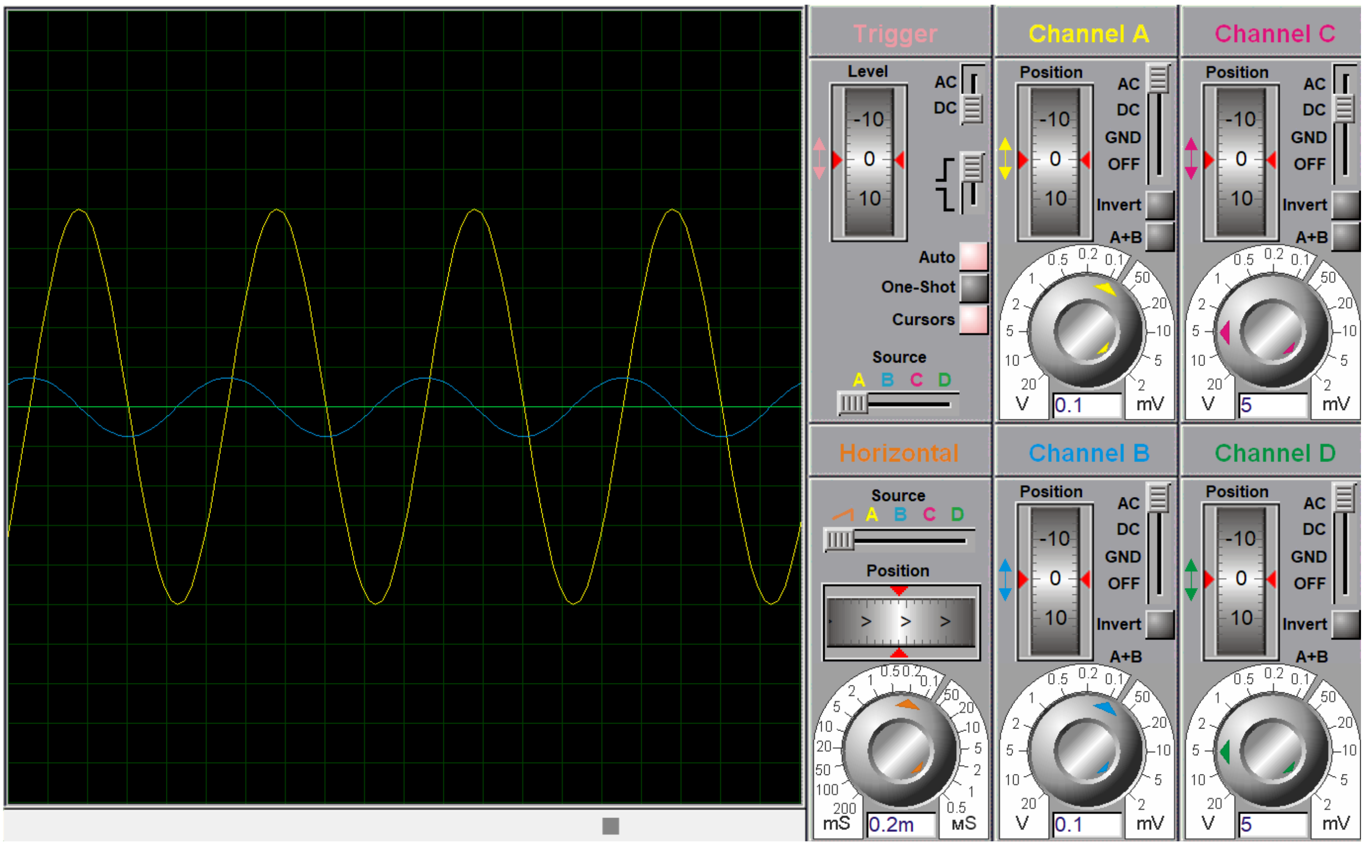
(3)



Trigger
Level
AC
DC
-10
0
10
Auto
One-Shot
Cursors
Source
A B C D
Channel A
Position
AC
DC
GND
OFF
Invert
A+B
V
0.1
mV
Channel C
Position
AC
DC
GND
OFF
Invert
A+B
V
5
mV
Horizontal
Source
A B C D
Position
mS
0.2m
uS
Channel B
Position
AC
DC
GND
OFF
Invert
A+B
V
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mV
Channel D
Position
AC
DC
GND
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A+B
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mV

Discussion of Experimental Session 1: Operational Amplifier Applications

The first lab session was on the experiments in the different uses of operational amplifiers in several electronic circuits. In the phase shifter experiment, the relationship in terms of the frequency between the input signal and the phase shift is shown. This experiment provided how a RC circuit results in a phase shift-the experimental results were as theorized with respect to the input frequency. A phase shift can be created by the change in resistor and capacitor values; this is also applied to show the contribution of an Op-Amp in signal manipulation. In the Astable Multivibrator experiment, it deals with an Op-Amp used for generating a continuous square wave-a very key signal in systems like timing and clock generation. The period and frequency of the waveform were pre-set through the resistive and capacitive components in the circuit, and these are calculated and compared to the experimental results. The experiment of Schmitt Trigger explained how hysteresis could be used to convert noisy signals into clean digital transitions. The Op-Amp circuit was able to filter off the noise from the input through setting threshold voltages, hence giving a stable output. Finally, the Integrator circuit was explored to observe how an Op-Amp could perform integration of an input signal-turning a square wave input into a triangular waveform-the output amplitude dependent upon the RC values. This session will reinforce for the student the versatility of Op-Amps in analog signal processing and allow a deeper realization of their importance in timing, conditioning, and integration applications.

Discussion of Experimental Session 2: Study of Diac and Triac

The second session was taken up with the study of Diacs and Triacs, two semiconductor devices very commonly used in AC power control applications. In the experiment on Diac, it was demonstrated that the device conducts current when the applied voltage across it exceeds its breakover voltage. This behavior of a Diac is very essential for triggering devices like Triacs used to control the flow of AC power. The following lab represents the observation and analysis of some symmetrical characteristics of the Diac-conducting in both positive and negative directions once the breakover voltage is exceeded. The Triac experiments below are concentrated on both the Amplitude Control and Phase Control techniques for the control of the Triac's conduction. In amplitude control, the variation in gate current changed the Triac's triggering point, hence the conduction angle and, therefore, the amount of power delivered to the load. This method allowed the controlling of power delivered, although only for less than half of each AC cycle. In contrast, the Phase Control experiment provided a more refined method of controlling the Triac: by delaying its triggering point inside the AC cycle. Therefore, by adjusting the phase delay, we were able to achieve more precise control over the power delivered; the conduction angles have been varied accordingly. These experiments underlined the importance of Diacs and Triacs in AC power regulation, especially in light dimming and speed control of motors.

Discussion of Experimental Session 3: Summing and Difference Circuits

The third session focused on Summation and Difference circuits using an operational amplifier. Such kinds of circuits are very crucial and form the backbone of many applications in analog signal processing; for example, the processing of audio signals or the amplification of differential inputs. The experiment on Summing Circuit explained how several input voltages can be summed to yield one output voltage, a weighted sum of the applied input voltages. Linear in all input voltages, in the output voltage, with an weighting provided by the respective resistive components. Predicted by theory, the real results showed that the mentioned circuit indeed sums the inputted signals. The Difference Circuit experiment shows how the voltage difference of two input voltages may get amplified. This is useful in applications that require the extraction of difference between two signals, which is commonly done in instrumentation amplifiers. The voltage output was measured by subjecting different input voltages, and the difference was indeed proportional to the difference between the inputs as anticipated for a difference amplifier. By large, these experiments underlined how important Op-Amp circuits were with respect to signal manipulation. An amplifier can add or subtract the signal according to his interest.

Discussion of Experimental Session 4: Passive Filter Circuits

The fourth session went deep into Passive Filter Circuits that are designed using resistors, capacitors, and inductors. It furthered the understanding of how various filter types-low-pass, high-pass, and band-pass-operate to allow certain frequencies to pass while others are attenuated. In the Low-Pass Filter, low-frequency signals passed while higher frequencies were blocked; this is determined by the values of the resistor and capacitor. Similarly, in the High-Pass Filter, high-frequency signals were allowed to pass while those of low frequency were blocked off, where the cut-off frequency could be computed on the same basis. The Band-Pass Filter combines low-pass with high-pass to provide a certain range of frequencies where the output is not attenuated, whereas signals outside that range are attenuated. The application of these filters spreads in a wide domain for signal processing, starting with audio systems and communications. The input frequency was varied and the output viewed on the oscilloscope to measure the cutoff frequency, and the effect of both on the signal amplitude. Results confirmed what was expected from the two filters. This session provides insight into how passive filters are used to control signal frequency content in electronic systems.

Discussion of Experimental Session 5: Active Filter Circuits

The last session in the lab covered Active Filter Circuits. Unlike passive filters, active filters are filters which depend on active elements like an operational amplifier for providing a gain as well as filtering. The objective of this session was to study low-pass, high-pass, and band-pass active filters that may provide superior control and performance to that of the passive ones. In the experiment on the Low-Pass Active Filter, it was observed how signals with frequencies lower than the cut-off frequency passed through the circuit while the higher ones were attenuated. Similarly, in the case of a High-Pass Active Filter, high-frequency signals passed through it while lower ones were attenuated. The major advantage of active filters is that they can provide gain to compensate for signal attenuation in the filter design. The design problem of the Band-Pass Active Filter experiment required designing a filter of specified characteristics: the 3 dB frequency, 1 kHz, with a Q of 0.8. The active filters were simulated in proteus and compared with theoretical design. The results obtained showed that active filters are more flexible and controlled in frequency response compared to passive filters, and their application can be extended to signal amplification and critical filtering. This session showed how active filters can practically be applied in real-life signal processing.