Lab-2

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Matlab Experiment:

```
Matlab Code:
       Fs = 20; % Sampling frequency (20 Hz)
T = 1/Fs; % Sampling period
t = 0:T:2-T; % Time vector for 2 seconds
f1 = 5; % Frequency of first cosine signal (5 Hz)
f2 = 8; % Frequency of second cosine signal (8 Hz)
x = cos(2*pi*f1*t) + cos(2*pi*f2*t); % Original signal (sum of cosines)
% Sampling the signal
n = 0:length(t)-1; % Sample indices
x sampled = cos(2*pi*f1*n*T) + cos(2*pi*f2*n*T); % Sampled signal
% Low-Pass Filter (LPF) using sinc interpolation
t reconstruct = linspace(0, 2, 1000); % High-resolution time vector
x reconstruct = zeros(size(t reconstruct)); % Initialize reconstructed signal
for i = 1:length(n)
  x reconstruct = x reconstruct + x sampled(i) * sinc(Fs*(t reconstruct-n(i)*T));
end
% Plotting the results
figure;
subplot(3,1,1);
plot(t, x, 'b', 'LineWidth', 1.5);
title('Original Signal');
xlabel('Time (s)');
ylabel('Amplitude');
```

```
grid on;

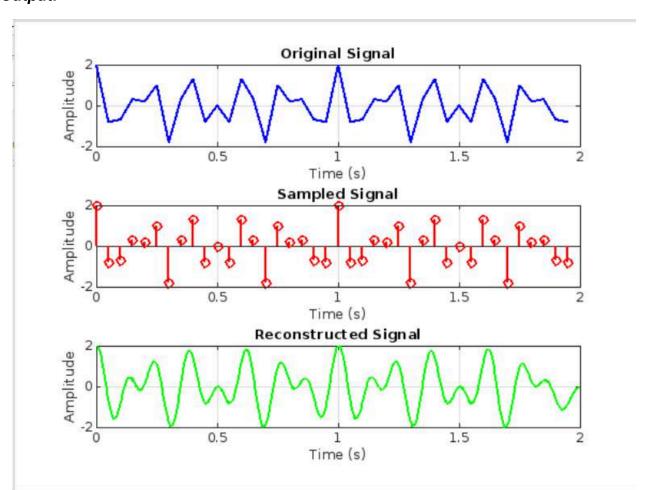
subplot(3,1,2);
stem(n*T, x_sampled, 'r', 'LineWidth', 1.5);
title('Sampled Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;

subplot(3,1,3);
plot(t_reconstruct, x_reconstruct, 'g', 'LineWidth', 1.5);
title('Reconstructed Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;
```

Explanation:

This MATLAB code samples a signal composed of two cosine waves (5 Hz and 8 Hz) at 20 Hz, reconstructs the signal using sinc interpolation (low-pass filtering), and then plots the original, sampled, and reconstructed signals for comparison.

Output:



Experiment 1:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|-----------------------|------------------------|---------------|--|
| Sine/500 Hz | Channel1 | - | CHU County At County At Child Evil Child Evi |
| Arbitrary /1.5 KHz | Channel2 | - | RIGOL DS1102C OCHE COLLEGO URLA SCHOOL RIGHT COLLEGO RIGHT COL |
| Sine/500 Hz | Channel1 | 8 KHz | Couping AC Boy Linit USE Probe 1X USE Francis 23 - 68/07; Pysis 1-10, 1994 Tino, 200, Bac 11, 1994 |

| Sine/500 Hz | Channel1 | 8 KHz | Price State |
|----------------------|----------|-------|---|
| Arbitrary /500 Hz | Channel2 | 8 KHz | Probe Total Color First Color Color Color First Color Color Color First Color Color Color First Color |
| Arbitrary /500 Hz | Channel2 | 8 KHz | Coupling AC AN AC AN AC |

- Through this experiment, we learned how different input signal frequencies and sampling rates influence the signals observed in the oscilloscope.
- We learned that adjusting the sampling frequency is crucial for representing the original signal accurately.

Experiment-2:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|----------------------|------------------------|---------------|--|
| Sine/500 Hz | Channel1 | 8 KHz | RISSL STOP Country Country AC Set Limit Rissl Ri |
| Arbitrary/5 00 Hz | Channel1 | 8 KHz | RIGHT ETCP Couping AC Couping AC Provided Fig. 1991. Page 1991. Pa |
| Sine /500 Hz | Channel2 | 8 KHz | RIGHT STOP COUNTY COUNT |

- Through this experiment, we showed that the line speed frequency directly impacts the PCM clock and the PCM output.
- Changes in the line speed directly affected the timing and quality of the PCM output signal.

Experiment-3:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|-------------|------------------------|---------------|---|
| Sine/500 Hz | Both | 8KHz | Couping AC BW Lami Freeds (25-866) Proling (889.5) Cally 2.680 (888) 2.600 Time 18.600s |
| Sine/500 Hz | Both | 8 KHz | 2.000 Ties 5.000x WG, 0000x |

| Sine/500 Hz | Both | 8 KHz | Place Stop Coupling AC Byy Limit 1 fr Probe 1X Digital Filter 1-2 1-2 1-2 1-2 1-2 1-2 1-2 1-2 1-2 1-2 |
|-------------|------|-------|---|
| Sine/500 Hz | Both | 8 KHz | City 2,000 Bell 2,000 Five 2,000,0000 |

- Through this experiment, we learned how a 17 bit multiplexed output frame is structured with a framing pulse.
- The framing pulse is added for synchronization of frames.
- They help maintain alignment of channels within the frame.

Experiment-4:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|-------------|------------------------|---------------|--|
| Sine/500 Hz | Both | 8KHz | Probe 1X Cylul Filer CHIA 2.680 SERM 2.680 Time 5.686uz Bio.0000s |
| Sine/500 Hz | Both | 8 KHz | RIGOL UST 102E 000 TAL CONCLUSIONE RIGOL STOP CH2 Coupling AC BW Livrit (CH2 Coupling) AC BW Livrit (CH2 Couplin |
| Sine/500 Hz | Both | 8 KHz | RIGOL DS1102E INFRA DICUMPOSS RIGOL STOP INFRA DICUMPOSS SOUTH INFRA DICUMPOSS SOUTH INFRA DICUMPOSS SOUTH INFRA DICUMPOSS SOUTH INFRA DICUMPOSS RIGOL DS102E |

- Through this experiment, we learned how detecting the framing pulse enables the system to correctly synchronize and output a 16 bit frame.
- It helps us understand the critical role of the framing pulse in ensuring that the data is accurately aligned and transmitted in intended format.

Experiment-5:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|----------------------|------------------------|---------------|--|
| Sine/500 Hz | Channel1 | 8KHz | RIGOL STOP LICENSE CONTROL CONTROL STOP LICENSE CONTROL CONTRO |
| Arbitrary /500 Hz | Channel2 | 8KHz | R160L STOP |

- Through this experiment, we learned how PCM output was accurately separated into individual channels after demultiplexing.
- The framing pulse plays a key role in ensuring that each channel's signal was correctly identified and retrieved.
- This ensures integrity of original input signals throughout the process.

Experiment-6:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|----------------------|------------------------|---------------|--|
| Sine/500 Hz | Channel1 | 8KHz | RIGIO DISTRIUZE CONTROL OSCILLOROS 1000 Tien NO. See Particular |
| Sine/500 Hz | Channel1 | 8 KHz | RIGOL DS1102E DIGITAL DIGILOSCOPI RISOL STOP 400-NV 2.08U Time S00.0us @NT04.0us |
| Arbitrary/5 00 Hz | Channel2 | 8 KHz | RIGOL STOP |

Conclusion: Through this experiment, we learned how demodulated output from a TDM-PCM system accurately reconstructs the original input signal. By observing the signal at various points, we observe how the system effectively separates and retrieves each channel's data.

Experiment-7:

| Sr.no | Input signal and freq. | Sampling frq. | Input and Output signals |
|----------------------|------------------------|---------------|---|
| Sine/500 Hz | Channel1 | 8KHz | RIGOL DS11U2E |
| Sine/500 Hz | Channel1 | 8 KHz | HISSE STOP CONTROL OF THE STOP LOAD BY 1 LIANS |
| Arbitrary/5 00 Hz | Channel2 | 8 KHz | RIGIO STOP COLOR Z. 680 Time Cold. flux (in 1. 12 flux) |

| Arbitrary/5 00 Hz | Channel2 | 8 KHz | RIOCL STOP 100 00000000000000000000000000000000 |
|----------------------|----------|-------|---|
| Square/500 Hz | Channel1 | 8KHz | RIOU. STOP Procedures Control of the Soot Burg Grant Education Control of the |
| Square/1 KHz | Channel1 | 8KHz | RIGOL DS1102C DIGITAL OFFICE PROPERTY AND |

| Square / 1.5KHz | Channel1 | 8KHz | RIGOL DS1102E SECRET SCHOOL STOP RIBUR STOP CHI CHI CHI CHI CHI CHI CHI CH |
|--------------------|----------|------|---|
| Square / 3 KHz | Channel1 | 8kHz | RIGOL DSTITUZE DIGITAL OSCILLOSCOPE 2 Channel 1000-FFL (GSL/s) RIGOL STOP 1 400ml 1 1.000 CMSM 1.0001 Time 200.0us CM1.160ms |
| Square / 2 KHz | Channel1 | 8kHz | FIRST STOP TO LOCATION AND THE STORY OF THE |

- Through this experiment, we learned how the low pass filter effectively smoothes out the demodulated signal.
- It then converts the original square wave into a more rounded waveform due to the LPF's RC characteristics.