Experiment 04: PCM - Answer Book

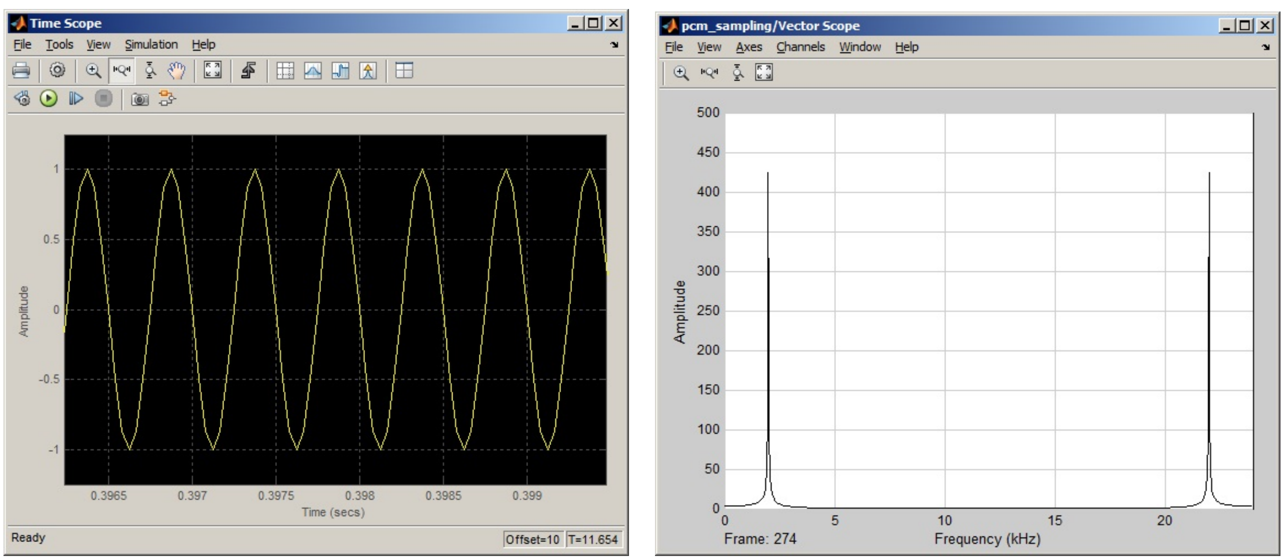
- **Name:** **Lab Date:**
- **Student No.:** **Day of the week:** **Time:**
- **Name:** **TA Signature:**
- **Student No.:** **Grade:**

1. Experiment

1.1 Sampling

1.1.1 Simulation

- *Figure 1(a) and Figure 1(b) show the time domain and frequency domain output of a system presenting aliasing. Determine the input frequency from the two plots given and identify the aliased component (write your answer in the box below the figures).* **[1.0]**



(a) Time Domain Display (b) Frequency Domain Display

Figure 1. Simulated Time Domain and Frequency Domain Display Presenting Aliasing

- *On your simulated system, increase the decimation factor to 6. What is the new sampling rate and new Nyquist limit? Sketch the output signal observed in the frequency domain, from 0 to 24KHz. (It may be painful)* **[1.0]**

1.1.2 Implementation

- *After making your system run on the DSP. The input should be a* $1V_{pp}$ *sine wave, 1KHz, sampled at 48KHz, decimated by a factor of 4. In the box below, provide the values of each of the four components displayed on the oscilloscope in FFT mode (Math button). At what input frequency should aliasing start occurring?***[1.5]**

- *Change your input signal to 11KHz and look at the frequency domain on the scope. Compare it with the 1KHz output. How can you determine which one is your signal and which one is the alias?* **[1.0]**

- *Set your input signal to 6KHz (or something very close to it, like 5.999 or 6.001Khz) and look at the frequency domain display. Why does the signal seem to disappear sometimes?* **[1.0]**

1.2 Quantization

- *Put your system to run on the DSP board, and set your mask to be* **0x8000**. *Sketch your result and explain what is being selected.* **[1.0]**

- *Change your mask to allow for 16 quantization levels. What is the mask to be utilized?* **[0.5]**

- *Use a 2 bit data word to quantize the input signal. Now gradually reduce the input voltage level until your output "jumps" to the lower quantization step. What is the value of that step in volts? It may be a good idea to overlap the direct signal with the quantized one, and see how that happens.* **[0.5]**

- *Change your input back to* $1.8V_{pp}$. *Sketch the original signal, the quantized signal, and the quantization error by using the* `Subtraction` *function in* `Math` *mode on the oscilloscope. The quantization error is the difference between the original signal and its quantized version.* **[1.0]**

- *Set your mask to 3 bits, measure the quantization error, then set your mask to 4 bits and measure it again. What is the difference in dB on the quantization error for a 1 bit difference on the quantizer?* **[1.5]**