

Laboratory Instructions

Course Number:	XMUT220
Laboratory Number:	5
Laboratory Title:	Sampling and reconstruction
Exercise 1: Transient response of signal sampling. Exercise 2: Frequency spectrum analysis of signal sampling. Exercise 3: Signal decimation and interpolation.	

Name: _____

Student Number: _____

1. By using a sampling signal at frequency of 1 kHz, perform sampling on the following continuous time signals.

   - $x_1 = x(t) = 25\cos(500\pi t)$
   - $x_2 = 3\cos(50\pi t) + 10\sin(300\pi t)$
   - $x_3 = \text{sinc}(200\pi t)$

   a. Simulate the time domain plot of the signals in MATLAB. [15 marks]

   - $x_1 = x(t) = 25\cos(500\pi t)$

- $x_2 = 3\cos(50\pi t) + 10\sin(300\pi t)$

- $x_3 = \text{sinc}\,(200\pi t)$

b. Comment on the results of the sampling. [10 marks]

2. You are given the following continuous time signal.

$$x(t) = 3\cos(50\pi t) + 10\sin(300\pi t) - \cos(100\pi t)$$

a. It is required that you carry out sampling process on the signal in MATLAB. Plot and describe the frequency spectrum of the sampled signals at these sampling frequencies:

i. 10 Hz. [10 marks]

ii. 100 Hz. [10 marks]

iii. 1000 Hz. [10 marks]

b. Describe signal aliasing. Determine whether aliasing existed in part (a). [10 marks]

3. Consider a continuous time signal given in the following equation:

$$x(t) = 1.5\cos(2\pi f_1 t) + \cos(2\pi f_2 t)$$

if f_1 = 100 Hz and f_2 = 200 Hz and sampling frequency is 1 kHz, perform the following tasks and obtain the relevant plots in MATLAB.

a. Sample the signal and get its discrete-time signal and describe the result. [10 marks]

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b. Interpolate this signal by factor I = 3 and describe the result. [10 marks]

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c. Decimate this interpolated signal by factor D = 3 and describe the result. [10 marks]

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d. Based on the simulation results of parts (b) and (c), describe decimation and interpolation methods. How these methods are used in signal processing applications? [5 marks]