EE6402 Real-Time DSP Design and Applications

Continuous Assessment 1

Please write your **name** and **matriculation number** in your solution, then submit (any format) to NTULearn by **17/2/23**. Penalties apply for late submission. *Please do not copy or let others copy your solutions.* — Anamitra Makur

If your matriculation number is $Ad_6d_5d_4d_3d_2d_1d_0B$, where A and B denote letters, and d_0 to d_6 denote decimal digits, then use your digits in the following questions.

Q1. Do the following depending on your matriculation number. [10]

(i) Express the number $a = (-1)^{d_3}\left(d_2 + \frac{d_1}{10}\right)$ in two's complement binary Q4.$(d_0 + 1)$ fixed point format. Use rounding if a is required to be quantized.

(ii) Express $b = d_6 + \frac{d_5}{10}$ in the same format as part (i) using the same quantization strategy.

(iii) Add these two binary numbers in Q4.$(d_0 + 1)$ format, to find their sum. Is there any overflow in this addition?

Q2. An input signal is quantized to $(d_3 + 1)$ binary fractional bits (after the binary point) using truncation. [10]

(i) What is the quantization step size?

(ii) What is the variance of the quantization error?

(iii) The input signal is filtered by the low-pass filter shown on the right. What is the output noise variance due to the input quantization noise?
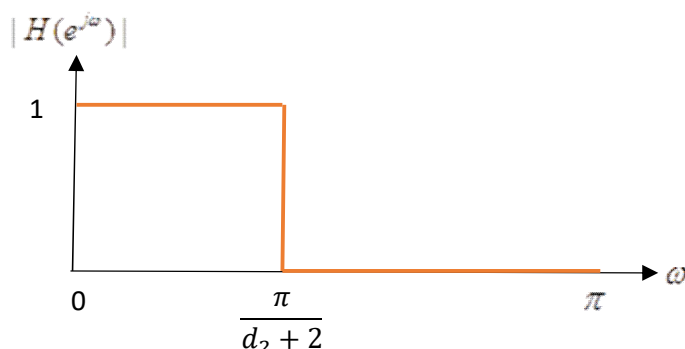
Q3. A band-pass signal of bandwidth $(d_1d_0)_{10} = 10d_1 + d_0$ KHz is centered around $(d_6d_5d_4)_{10} = 100d_6 + 10d_5 + d_4$ KHz. [10]

(i) Find all possible sampling frequencies for the signal such that there is no aliasing.

(ii) If the signal is sampled at 100 KHz, will there be aliasing?