



UNIVERSITY OF MORATUWA, SRI LANKA
Faculty of Engineering
Department of Electronic and Telecommunication Engineering
B.Sc. Engineering
Semester 4 - Batch 2018
Assignment 1

EN2570—DIGITAL SIGNAL PROCESSING

Total Marks: 70

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Q1. With proper justification, determine whether each of the following signals is periodic. If the signal is periodic, find its period. [10]

- (a) $2 \cos(\pi n/8)$
- (b) $\cos(3\pi n/4)$
- (c) $3 \cos(n/2)$
- (d) $2 \cos(\pi n/8) + \cos(3\pi n/4)$.

Q2. (a) The impulse response $h[n]$ of an LTI system is $a^n u[-n - 1]$, where $a > 1$. Determine the output $y[n]$ of the LTI system if the input $x[n]$ is $u[n]$. [15]

(b) Using the answer in **Q2(a)** and relevant properties of the system, find the the output of the LTI system if [15]

- i. $h[n] = 3^n u[-n - 1]$ and $x[n] = u[n - 3]$
- ii. $h[n] = 2^n u[-n - 3]$ and $x[n] = u[n] - u[n - 1]$.

Q3. The impulse response of an LTI system is $h[n] = a^n u[n] + b^n u[-n - 1]$, where $a, b \in \mathbb{C}$. Determine the conditions that should be satisfied by a and b in order to have a stable system. [10]

Q4. Consider the two signals $x_1(t) = 2 \cos(40\pi t)$ and $x_2(t) = 2 \cos(70\pi t)$.

- (a) If the signals $x_1(t)$ and $x_2(t)$ are sampled with 100π rad/s, find the digital angular frequencies (measured in rad/sample) of the corresponding discrete-time signals $x_1[n]$ and $x_2[n]$. [4]
- (b) Consider the signal $x[n]$ defined by $x[n] = x_1[n] + x_2[n]$. Sketch the frequency spectrum $X(e^{j\omega})$ of $x[n]$ in the range $-\pi \leq \omega \leq \pi$, where ω is the digital angular frequency. [10]
- (c) Assume that the signal $x[n]$ is applied to an ideal reconstruction filter of which the output is $\hat{x}(t) = A_1 \cos(\Omega_1 t) + A_2 \cos(\Omega_2 t)$, where A_1 , A_2 , Ω_1 , and Ω_2 are constants. What are the values of analog angular frequencies Ω_1 and Ω_2 ? [6]