**SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY**
**DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING**
**ACADEMIC YEAR 2019-2020 SEMESTER 1**
**EE323 DIGITAL SIGNAL PROCESSING**
**TUTORIAL 1**

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1. Consider the following sequences:

$$x[n] = \{2, 0, -1, 6, -3, 2, 0\}, \qquad -3 \le n \le 3,$$
$$y[n] = \{8, 2, -7, -3, 0, 1, 1\}, \qquad -5 \le n \le 1,$$
$$w[n] = \{3, 6, -1, 2, 6, 6, 1\}, \qquad -2 \le n \le 4.$$

The sample values of each of the above sequence outside the ranges specified are all zeros. Generate the following sequences.
(a) $c[n] = x[n+3]$, (b) $d[n] = 4y[n-2]$,
(c) $e[n] = y[1-n]$, (d) $u[n] = x[n-3] + y[n+3]$,
(e) $v[n] = y[n-3] \cdot w[n+2]$.

2. Let $\tilde{x}_1[n], \tilde{x}_2[n], \tilde{x}_3[n]$ be periodic sequences with fundamental periods, $N_1$, $N_2$, and $N_3$, respectively. Is a linear combination of these three periodic sequences a periodic sequence? If it is, what is its fundamental period?

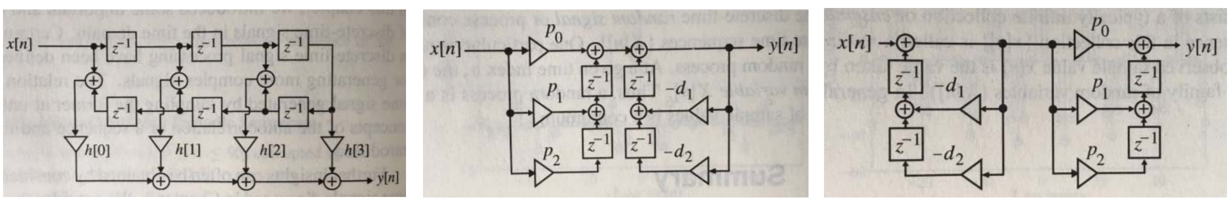
3. (a) Show that a causal real sequence $x[n]$ can be fully recovered from its even part for all $n \ge 0$, whereas it can be recovered from its odd part for all $n > 0$.
(b) Is it possible to fully recover a casual complex sequence $y[n]$ from its conjugate antisymmetric part? Can $y[n]$ be fully recovered from its conjugate symmetric part? Justify your answers.

4. Express the sequence $x[n] = 1$, $-\infty < n < \infty$, in term of the unit step sequence $u[n]$.

5. Determine the fundamental period of the following periodic sequence $x[n]=\cos(\omega_0 n)$ for the following values of the angular frequency $\omega_0$:
(a) $0.14\pi$, (b) $0.24\pi$, (c) $0.34\pi$, (d) $0.75$ (note: no $\pi$ here!)

6. A continuous-time sinusoidal signal $x_a(t) = \cos(\Omega_0 t)$ is sampled at $t = nT$, $-\infty < n < \infty$, generating the discrete-time sequence $x[n] = x_a(nT) = \cos(\Omega_0 nT)$. For what values of $T$ is $x[n]$ a periodic sequence? What is the fundamental period of $x[n]$ if $\Omega_0 = 18$ radians and $T = \frac{\pi}{6}$ seconds?

7. The following three schematics are operations developed using the three basic operations: addition, multiplication, and delaying. Develop the expression for $y[n]$ for each operation as a function of $x[n]$.




(a) (b) (c)