DSA-Assignment-2

Deadline: 5th April 2024

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1. Solve all the question and submit a handwritten document
2. Plagiarism will be penalised
3. Submit a pdf of the form <**roll_no**>_**dsa2.pdf**

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1 Signals

1. Indicate if the following signals are periodic signals. If periodic, find the fundamental period

(a) $x[n] = \sin^2(3n + \pi)$

(b) $x[n] = e^{j\pi n/8}$

(c) $x[n] = \cos(\pi n/10)\cos(\pi n/30)$

(d) $x[n] = \sin(4\pi n + 3)$

(e) $x[n] = \cos(\pi n^2/3)$

(f) $x[n] = \sum_{k=-\infty}^{\infty} (-1)^k \delta(n-k)$

2. Find the odd and even parts of the following discrete signals

(a) $x[n] = \sqrt{2}cos((an + 1/4)\pi)$

(b) $x[n] = e^{jan\pi} + e^{jn\pi/b}$

3. Determine whether the following signals are energy or power signals or neither

(a) $x[n] = \begin{cases} 0 & n < 0 \\ n & n \geq 0 \end{cases}$

(b) $x[n] = \cos(n\pi/2)$

(c) $x[n] = \begin{cases} 3^n & n < 0 \\ (\frac{1}{2})^n & n \geq 0 \end{cases}$

(d) $x[n] = a^n u(n), a \in R$

(e) $x[n] = e^n \delta(n-4)$

2 Systems

1. Determine whether or not the following systems are time invariant:

   (a) $y(t) = t^2 x(t-1)$

   (b) $y[n] = x[n-1] + x[n+1]$

   (c) $y[n] = \frac{1}{x[n]}$

   (d) Consider a system S with input $x[n]$ and output $y[n]$ related by $y[n] = x[n](g[n] + g[n-1])$.

      (a) If $g[n] = 1$ for all n, show that S is time invariant.

      (b) If $g[n] = n$, show that S is not time invariant.

      (c) If $g[n] = 1 + (-1)^n$, show that S is time invariant.

2. Determine whether or not the following systems are linear:

   (a) $y(t) = x(\sin t)$

   (b) $y(t) = \begin{cases} 0 & \text{if } t < 0 \\ x(t) + x(t-2) & \text{if } t \geq 0 \end{cases}$

   (c) $y(t) = \frac{d(x(t))}{dt}$

   (d) $y[n] = \sum_{m=0}^{M} ax[n-m] + \sum_{m=1}^{N} bx[n-m]$

   (e) $y[n] = ax[n] + \frac{b}{x[n-1]}$

3. Determine whether or not the following systems are causal:

   (a) $y(t) = x(t-2) + x(2-t)$

   (b) $y(t) = x(t) \cdot \cos(3t)$

   (c) $y(t) = \int_{-\infty}^{2t} x(k)dk$

   (d) $y[n] = \sum_{k=0}^{\infty} x[n+k]$

   (e) $y[n] = \sum_{k=0}^{\infty} x[n-k]$

3 Convolution

1. Find the linear and circular convolution of the sequences $x[n] = \{-1, 1, 0, 1\}$ and $h[n] = \{1, 2, 3, 4, 5\}$.

2. Compute the circular convolution of $x_1[n] = \{2, 1, 2, 1\}$ and $x_2[n] = \{1, 2, 3, 4\}$ using DFT and IDFT.