Ameer Alkam - 1120217

Exercise 1.2

$$X\left[n\right]\rightarrow \sum\_{k=0}^{n}X\left[k\right]=y\left[n\right]$$

1. Time-Invariance:

$$X\left[n-t\right]\rightarrow \sum\_{k=0}^{n-t}X\left[k\right]=Y\left[n\right]$$

$$Y\left[n\right]=y\left[n-t\right]$$

$$∴system is time invariant.$$

1. Stability:

$$given bounded input X\left[n\right]=u\left[n\right];unit step function$$

$$u\left[n\right]\rightarrow \sum\_{k=0}^{n}u\left[k\right]=y\left[n\right]$$

$$y\left[n\right] grows unboundedly, ∴system not BIBO stable.$$

1. Causality:

$$System doesn^{'}t rely on future values, ∴system is causal.$$

1. Linearity:

$$X1\left[n\right]\rightarrow \sum\_{k=0}^{n}X1\left[k\right]=y1\left[n\right]$$

$$X2\left[n\right]\rightarrow \sum\_{k=0}^{n}X2\left[k\right]=y2\left[n\right]$$

$$αX1\left[n\right]+βX2\left[n\right]\rightarrow \sum\_{k=0}^{n}αX1\left[k\right]+βX2\left[k\right]=α\sum\_{k=0}^{n}X1\left[k\right]+β\sum\_{k=0}^{n}X2\left[k\right]=αy1\left[n\right]+βy2\left[n\right];∴system is linear.$$

$$X\left[n\right]\rightarrow \sum\_{k=n-10}^{n+10}X\left[k\right]=y\left[n\right]$$

1. Time-Invariance:

$$X\left[n-t\right]\rightarrow \sum\_{k=n-t-10}^{n-t+10}X\left[k\right]=Y\left[n\right]$$

$$Y\left[n\right]=y\left[n-t\right]$$

$$∴system is time invariant.$$

1. Stability:

Given a bounded input $X\left[n\right]$, the output will always be the sum of 20 elements, with finite values, and would always be bounded.

$$∴System BIBO stable.$$

1. Causality:

$$System DOES rely on future values, ∴system is not causal.$$

1. Linearity:

$$X1\left[n\right]\rightarrow \sum\_{k=n-10}^{n+10}X1\left[k\right]=y1\left[n\right]$$

$$X2\left[n\right]\rightarrow \sum\_{k=n-10}^{n+10}X2\left[k\right]=y2\left[n\right]$$

$$αX1\left[n\right]+βX2\left[n\right]\rightarrow \sum\_{k=n-10}^{n+10}αX1\left[k\right]+βX2\left[k\right]=α\sum\_{k=n-10}^{n+10}X1\left[k\right]+β\sum\_{k=n-10}^{n+10}X2\left[k\right]=αy1\left[n\right]+βy2\left[n\right];∴system is linear.$$

$$X\left[n\right]\rightarrow X\left[-n\right]=y\left[n\right]$$

1. Time-Invariance:

$$X\left[n-t\right]\rightarrow X\left[-\left(n-t\right)\right]=X\left[t-n\right]=Y\left[n\right]$$

$$Y\left[n\right]\ne X\left[-n-t\right]\ne y\left[n-t\right]$$

$$∴system isn't time invariant.$$

1. Stability:

Given a bounded input $X\left[n\right]$, the output will always be the same value as the input but mirrored, and would have no infinite values.

$$∴System BIBO stable.$$

1. Causality:

System non-causal, since the input at n=-2 would require knowledge of the future at n=+2 to be outputted.

1. Linearity:

$$X1\left[n\right]\rightarrow X1\left[-n\right]=y1\left[n\right]$$

$$X2\left[n\right]\rightarrow X2\left[-n\right]=y2\left[n\right]$$

$$αX1\left[n\right]+βX2\left[n\right]\rightarrow αX1\left[-n\right]+βX2\left[-n\right]=αy1\left[n\right]+βy2\left[n\right];∴system is linear.$$