Digital Signal Processing

http://kom.aau.dk/~zt/cources/Digital_signal_processing/

Solutions 1 (MM1)

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Exercise 1.1
       x =   1  -2   4   6  -5   8  10
       n =  -4  -3  -2  -1   0   1   2

(a)
   x1(n) =   3  -6  10  22 -23  12  41 -18 -16   6  -5   8  10
       n =  -6  -5  -4  -3  -2  -1   0   1   2   3   4   5   6

(b)
   X2(n) =   0   8 -20   0  -50 64  -50  0
       n =  -4  -3  -2  -1   0   1   2   3
```

Exercise 1.2

$$T_1[x(n)] = \sum_{k=0}^{n} x(k)$$

(a) Not stable: $x(k) = M, \quad T_1[x(n)] = (n+1)\cdot M, \quad As \quad n \to \infty, T_1 \to \infty.$

(b) Not causal: when n is smaller than 0, T1 depends on future values of x.

(c) Linear: $T_1[ax_1(n) + bx_2(n)] = aT_1[x_1(n)] + bT_1[x_2(n)]$

(d) Not time-invariant: $T_1[x_1(n)] = \sum_{0}^{n} x_1(k) = \sum_{0}^{n} x(k-n_0) \neq y_1(n) = y(n-n_0) = \sum_{0}^{n-n_0} x(k)$

$$T_2[x(n)] = \sum_{k=n-10}^{n+10} x(k)$$

(a) Stable: $x(k) \le M, \quad T_2[x(n)] \le 21\cdot M.$

(b) Not causal: refer to future values.

(c) Linear: as in 1.2 (c).

(d) Time-invariant: $T_2[x_1(n)] = \sum_{n-10}^{n+10} x(k-n_0) = y_1(n) = y(n-n_0) = \sum_{n-n_0-10}^{n-n_0+10} x(k)$

Exercise 1.3

$$y[n] = \delta[n] + \frac{1}{2}\delta[n-1] + \frac{1}{2}\delta[n-2] - \frac{1}{2}\delta[n-3]$$