TH OWL; Prof. Meier; written exam DSS; 2022-03-25 (Master)

Results

Problem 1

1E, 2C, 3H, 4G, 5F, 6D, 7B, 8A

Problem 2

2.1 $X(f) = -\mathrm{j}\pi \cdot \mathrm{sgn}(f) \cdot \mathrm{e}^{-2\pi \cdot |f|}$

2.2 1) linear, time-invariant, causal, memory
2) non-linear, time-variant, not causal, memory

Problem 3

3.1 +60 dB / decade for $\omega \ll 10$, 0 dB for $\omega \gg 100$

3.3 0 dB for $\omega \geq 100$, +40 dB / decade for $10 \leq \omega \leq 100$, +60 dB / decade for $\omega \leq 10$

Problem 4

4.1 Plot spectrum

4.2 23.33 Hz < f_s < 25 Hz

Problem 5

5.1 $\dfrac{\mathrm{d}^2 y}{\mathrm{d}t^2} + 3y = \dfrac{\mathrm{d}x}{\mathrm{d}t} + x$

5.2 $y[n] - 2 \cdot y[n-1] + \left(1 + 3T_\mathrm{s}^2\right) \cdot y[n-2] = T_\mathrm{s} \cdot x[n-1] + T_\mathrm{s} \cdot (T_\mathrm{s} - 1) \cdot x[n-2]$

Problem 6

6.1 $p_{1,2} = 0.1 \pm \mathrm{j}0.2$; $z_1 = 0$

6.2 stable, minimal-phase system

6.3 $h[n] = \mathrm{j} \cdot \dfrac{1}{8} \cdot \left\{ -(0.1 + \mathrm{j}0.2)^n + (0.1 - \mathrm{j}0.2)^n \right\} \cdot u[n]$

$h[0] = 0 = \lim\limits_{z \to \infty} H(z)$

6.4 Chapter 5, page 61: $b_0 = 0$, $b_1 = 1/20$, $b_2 = 0$, $a_1 = -1/5$, $a_2 = 1/20$

Problem 6

6.1 $x[n] = \sin\left(n \cdot \dfrac{\pi}{2}\right)$

6.2 $\Delta f = 0.2$ Hz , $N = 10{,}000$, increase observation time