Results

Problem 1

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

Problem 2

2.1 $X(f) = \dfrac{1}{1+\mathrm{j}2\pi\cdot f}\cdot\left\{\mathrm{e}^{(1+\mathrm{j}2\pi\cdot f)\cdot\pi} - \mathrm{e}^{-(1+\mathrm{j}2\pi\cdot f)\cdot\pi}\right\}$

2.2 $Y(f) = \sum_{k=-\infty}^{+\infty} c_k\cdot\delta\left(f - k/(2\pi)\right)$ with $c_k = \dfrac{1}{2\pi}\cdot\dfrac{(-1)^k}{1+\mathrm{j}k}\cdot\left\{\mathrm{e}^{\pi} - \mathrm{e}^{-\pi}\right\} = \dfrac{1}{\pi}\cdot\dfrac{(-1)^k}{1+\mathrm{j}k}\cdot\sinh\pi$

2.3 $y_1(t) = \dfrac{\sqrt{2}}{\pi}\cdot\sinh\pi\cdot\cos\left(t+135°\right)$

Problem 3

3.1 $p_{1,2} = -2\pm\mathrm{j}$; $p_3 = -2$; $z_{1,2} = \pm\mathrm{j}$

3.2 -20 dB / decade for $\omega \gg 5$

3.3 $\dfrac{\mathrm{d}^3 y}{\mathrm{d}t^3} + 6\cdot\dfrac{\mathrm{d}^2 y}{\mathrm{d}t^2} + 13\cdot\dfrac{\mathrm{d}y}{\mathrm{d}t} + 10\cdot y = \dfrac{\mathrm{d}^2 x}{\mathrm{d}t^2} + x$

Problem 4

4.1 $f_\mathrm{s} \geq 40$ Hz

4.2 $X_\mathrm{s}(f) = 30$ Hz

4.3 $x_\mathrm{s}(t) = 30\ \mathrm{Hz}\cdot\delta(t)$

4.4 $f_\mathrm{s,min} = 55$ Hz

Problem 5

5.1 $p_1 = p_2 = \dfrac{1}{2}$; $p_3 = \dfrac{1}{3}$ $\Rightarrow$ stable

5.2 $h[n] = 6\cdot\left(\dfrac{1}{2}\right)^n\cdot u[n] - 5\cdot\left(\dfrac{1}{3}\right)^n\cdot u[n]$

Problem 6

6.1 $H(z) = \dfrac{z+(100\cdot T_\mathrm{s}-1)}{z+(500\cdot T_\mathrm{s}-1)}$

6.2 $0 < T_\mathrm{s} < \dfrac{1}{250}$

Problem 7

7.1 $x[n] = \{4\ ,\ 2\ ,\ 1\ ,\ 0\ ,\ 1\ ,\ 2\}$ with $0 \leq n \leq 5$

7.2 real and circular even