

0. (0 pts) Warmup exercises
 OW problems 10.3, 10.9, 10.10, 10.12, 10.20 (answers in back of book). These do not need to be turned in.

1. (16 pts) Lec 20, OW 9.5.10.
 Find the initial and final value for $x(t)$ given the causal Laplace transforms $X(s)$:

a) $\frac{s+1}{(s+2)(s+3)}$ b) $\frac{1}{s(s+1)}$ c) $\frac{s-1}{(s+1)}$ d) $\frac{1}{(s+2)(s+3)}$

2. (19 pts) Lec 21, OW 10.7, 10.9
 Solve the difference equation

$$y[n] - 0.5y[n-1] + 0.25y[n-2] = x[n]$$

using unilateral Z-transforms (assume causal), with $x[n] = \frac{1}{2}^n u[n]$. Initial condition: $y[-2] = 1, y[-1] = 3$.

3. (15 pts) Lec 20, 21, OW 10.5-10.9
 Given $h[n] = \alpha^n u[n]$ with $|\alpha| < 1$, and $x[n] = u[n] - u[n-N-1]$, find $y[n]$ using:

- a) $y[n] = h[n] * x[n]$
 b) Z transforms.

4. (15 pts) Lec 21, OW 10.3
 Determine the inverse Z transform (a causal sequence, $h[n]$) for the following Z transforms using:
 i) long division method and ii) partial fractions:

a) $H(z) = \frac{z^{-1} - \frac{1}{2}}{1 - \frac{1}{2}z^{-1}}$ b) $H(z) = \frac{z^{-1} - \frac{1}{2}}{(1 - \frac{1}{2}z^{-1})^2}$ c) $H(z) = \frac{1 - z^{-1}}{1 - \frac{1}{4}z^{-2}}$

5. (15 pts) DTFT Lec 20, OW 10.4
 Sketch the pole-zero diagram and $|X(e^{j\omega T})|$ for the following functions:

a) $X(z) = \frac{z-3/4}{z}$ b) $X(z) = \frac{1}{(z-3/4)(z+3/4)}$ c) $X(z) = \frac{(z+\frac{3}{4}e^{j\pi/4})(z+\frac{3}{4}e^{-j\pi/4})}{z^2}$

6. (20 pts) Digital Bandpass Filter OW 10.4, 10.9
 A signal $x(t)$ is sampled at $1/T_s = 16$ Hz. Design a filter $H(z)$ with 2 poles which has peaks at 4 Hz and 12 Hz, (normalized frequency $\omega T_s = \frac{\pi}{2}, \frac{3\pi}{2}$), with $|H(e^{j0})| = 1$ and $|H(e^{j\pi/4})| = 4$. Sketch pole-zero plot and $|H(e^{j\omega T_s})|$. Find the difference equation corresponding to this $H(z)$.