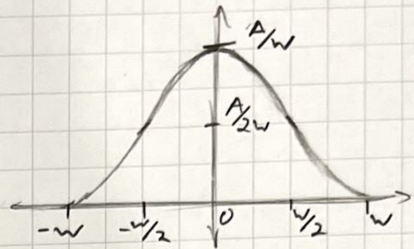
2.

$X(f) = \frac{A}{2W}[1+\cos(\frac{\pi f}{W})]\Pi(\frac{f}{2W})$

a) $X(0) = \frac{A}{2W}[1+1](1) = \frac{A}{W}$, $X(\pm W/2) = \frac{A}{2W}[1+0](1) = \frac{A}{2W}$

$\lim_{f\to\pm W} X(W) = 0$



b) $X(f) = \frac{A}{2W}[1+\cos(\frac{\pi f}{W})]\Pi(\frac{f}{2W}) = A[\frac{1}{2W}\Pi(\frac{f}{2W}) + \frac{1}{2W}\cos(\frac{\pi f}{W})\Pi(\frac{f}{2W})]$

$\mathcal{F}^{-1}(\frac{1}{2W}\Pi(\frac{f}{2W})) = \text{sinc}(2Wt)$

$\Downarrow$

$\mathcal{F}^{-1}(\frac{1}{2W}\cos(\frac{\pi f}{W})\Pi(\frac{f}{2W})) = \frac{1}{2}[\text{sinc}(2W(t-\frac{1}{2W})) + \text{sinc}(2W(t+\frac{1}{2W}))]$

$x(t) = A[\text{sinc}(2Wt) + \frac{1}{2}(\text{sinc}(2W(t-\frac{1}{2W})) + \text{sinc}(2W(t+\frac{1}{2W})))]$

c) $\text{sinc}(0) = \lim_{\xi\to 0}\frac{\sin(\pi\xi)}{\xi} = 1$ $\quad \sin(\pi n) = 0$

$\text{sinc}(n) = 0$ for integers $n \neq 0$

d) $x(t) = A[\text{sinc}(t/T) + \frac{1}{2}(\text{sinc}(1/T(t-T)) + \text{sinc}(1/T(t+T)))]$

$x(0) = A[1 + \frac{1}{2}(0+0)] = A$

$x(-T) = A[0 + \frac{1}{2}(0+1)] = A/2$

$x(T) = A[0 + \frac{1}{2}(1+0)] = A/2$

e) $x(kT) = A[\text{sinc}(k) + \frac{1}{2}(\text{sinc}(k-1) + \text{sin}(k+1))]$

for all integers $k \neq 0, \pm 1$, $\text{sinc}(k) = 0 \wedge \text{sinc}(k\pm 1) = 0$

$x(kT) = A[0 + \frac{1}{2}(0+0)] = 0$

3.

$u(t) = \frac{1}{1+t^2}$, $v(t) = \frac{t}{1+t^2}$

a)

$s_{USSB}(t) = u(t) + j v(t) = \frac{1}{1+t^2} + \frac{jt}{1+t^2} = \frac{1+jt}{1+t^2} = \frac{1+t^2}{(1+t^2)(1-jt)} = \frac{1}{1-jt}$

zero: No zeroes , poles: $t = -j$ => closed upper half plane

$s_{LSSB}(t) = u(t) - j v(t) = \frac{1}{1+t^2} - \frac{jt}{1+t^2} = \frac{1-jt}{1+t^2} = \frac{1+t^2}{(1+t^2)(1+jt)} = \frac{1}{1+jt}$

zero: No zeroes, poles: $t = j$ => closed lower half plane

b)

$|s_{USSB}(t)| = \frac{|1+jt|}{|1+t^2|} = \frac{\sqrt{1+t^2}}{1+t^2} = \frac{1}{\sqrt{1+t^2}}$ => decays at $\frac{1}{|t|}$

$|s_{LSSB}(t)| = \frac{|1-jt|}{|1+t^2|} = \frac{\sqrt{1+t^2}}{1+t^2} = \frac{1}{\sqrt{1+t^2}}$ => decays at $\frac{1}{|t|}$

$|u(t)| = \frac{1}{1+t^2}$ => decays at $\frac{1}{t^2}$

For $t > 1$, the envelopes of USSB and LSSB decay at a slower rate