HW Ch.4

Solution

Prob 1. 10 a) $x[m,n] \rightarrow \boxed{\uparrow(2,2)} \xrightarrow{z[m,n]} \boxed{H} \rightarrow y[m,n]$

$$z[m,n] = \begin{bmatrix} 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}, \quad y[m,n] = \begin{bmatrix} 0 & 1/2 & 1 & 1 & 1 \\ 0 & 1/2 & 1 & 1 & 1 \\ 0 & 1/2 & 1 & 1 & 1 \\ 0 & 1/4 & 1/2 & 1/2 & 1/2 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

10 b) $h[m,n] = f[m]\, f[n]$, $\quad f[m] = 0.5\,\delta[m-1] + \delta[m] + 0.5\,\delta[m+1]$

$$F(e^{j\omega}) = \text{DTFT}\{f[m]\} = 1 + 0.5e^{-j\omega} + 0.5e^{j\omega} = \underline{1 + \cos\omega}$$

$$\therefore H(e^{j\mu}, e^{j\nu}) = \text{DSFT}\{h[m,n]\} = (1+\cos\mu)(1+\cos\nu)$$

10 c) $Y(e^{j\mu}, e^{j\nu}) = X(e^{j2\mu}, e^{j2\nu}) \cdot H(e^{j\mu}, e^{j\nu})$

10 d) Adv: easy to compute; reduced aliasing compared to pixel replications.

Disadv.: Soften image due to attenuation in pass band;

allows some aliased frequency spectrum.