HW Ch. 2

Solution

Prob. 1. (a) 10 Yes, it's a linear space invariant sys.

(b) 10 $h[m,n] = \delta[m,n](1+\lambda) - \frac{\lambda}{9}\sum_{k=-1}^{1}\sum_{l=-1}^{1}\delta[m-k,n-l]$

$$= \begin{cases} 1+\frac{8}{9}\lambda, & m=n=0 \\ -\frac{\lambda}{9}, & |m|\le 1, |n|\le 1, \text{ but } m\ne 0, n\ne 0. \\ 0, & o/w. \end{cases}$$

(c) 10 $H(e^{j\mu}, e^{j\nu}) = (1+\lambda) - \frac{\lambda}{9}\sum_{k=-1}^{1}\sum_{l=-1}^{1} e^{-j\mu k} e^{-j\nu l}$

$$= (1+\lambda) - \frac{\lambda}{9}\sum_{k=-1}^{1} e^{-j\mu k}\sum_{l=-1}^{1} e^{-j\nu l}$$

$$= (1+\lambda) - \frac{\lambda}{9}(e^{-j\mu}+1+e^{j\mu})(e^{-j\nu}+1+e^{j\nu}).$$

$$= (1+\lambda) - \frac{\lambda}{9}(1+2\cos\mu)(1+2\cos\nu)$$

(d) 10 When $\lambda>0$ & large, $h[m,n]$ is a sharpening filter.

(e) 10 When $-1<\lambda<0$, $h[m,n]$ is blurry filter.

Prob. 2. (a) 5 $H(e^{j\mu}, e^{j\nu}) = \frac{1}{25}(e^{-j2\mu}+e^{-j\mu}+1+e^{j\mu}+e^{j2\mu})(e^{-j2\nu}+e^{-j\nu}+1+e^{j\nu}+e^{j2\nu})$

(analytical part)

$$= \frac{1}{25}(1+2\cos\mu+2\cos 2\mu)(1+2\cos\nu+2\cos 2\nu)$$

+ computer proj. = 10

(b) 5 $G(e^{j\mu}, e^{j\nu}) = (1+\lambda) - \frac{\lambda}{25}(1+2\cos\mu+2\cos 2\mu)(1+2\cos\nu+2\cos 2\nu)$

(analytical part)

+ computer proj. = 10

(c) 20 pts. for computer proj.

iyc:
-10: no implementation of 2d filter flip.
-5: incorrect 2d filter flip or
no implementation of 2d filter filp but
providing correct rationale.