## ELE 473 573 HW 3

## Due June 10

## May 27, 2019

1. What type of filters are the following filters. Rigorously prove your answer by calculating the Fourier Transforms and plotting (by hand) their magnitudes. You can use slices (1-D profile of the 2-D FT) for easier plotting.

$$F1 = 1/4 \times \begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix} \quad F1 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$
(1)

2. Consider continuous 2-D images. Show that rotation of an image in the spatial domain corresponds to the same rotation in the frequency domain.

3. What does correlation in 2-D correspond to in frequency domain. Prove your answer

4. Assume that we want to restore a 2-D discrete image by minimizing the following cost function  $E[(g - \hat{g})^2]$ 

where g is your measurement, f is the image we want to estimate, and  $\hat{g} = H[\hat{f}]$  with  $\hat{f}$  the estimated image. where the only distortion is the Poisson noise. That is, measured image is Poisson with mean  $\mu = f[m, n]$ , where m and n are pixel numbers and measurements are independent for each pixel. What would be the estimated image? Prove all your steps only using basic probability theory.

5. Calculate the 2-D Fourier Transform of a Gaussian Filter.