EEL715: Digital Image Processing **Minor II, IInd Sem 2014-15**
Max Marks: 40 **Duration: 1 hour**

Ques 1. The estimates of mean and variance of noise in an image are respectively given by 5 and 25. Obtain the exact pdf of noise if the noise type is
a) Exponential b) Uniform c) Erlang d) Rayleigh **(6)**

Ques 2. Given the following image

$$\begin{bmatrix} 2 & 3 & 4 & 2 & 3 \\ 1 & 3 & 3 & 1 & 2 \\ 2 & 4 & 8 & 2 & 1 \\ 1 & 4 & 4 & 2 & 3 \\ 1 & 4 & 3 & 3 & 1 \end{bmatrix}$$

For a neighbourhood of size 3X3, what is the result of applying the following filters on the circled pixel values
a) Geometric mean b) Harmonic mean c) Arithmetic mean **(6)**

Ques 3. Explain adaptive median filter. Explain why it outperforms regular median filter. **(4+2)**

Ques 4. What are the frequency domain expressions for (a) Weiner filter, (b) Constrained Least Squares filter? Compare the two filters and describe the difference in the two approaches to image restoration. **(2+4)**

Ques 5. Given

$$f(x,y) = \begin{cases} A; & x^2 + y^2 \le r^2 \\ 0 & \text{otherwise} \end{cases}$$

Obtain $p(\alpha, \beta)$ the fan beam projection corresponding to the slice $f(x,y)$ **(8)**

Ques 6. Given the following projections

$$g(\rho,\theta) = \begin{cases} 2A\sqrt{r^2 - \rho^2}; & |\rho| \le r \\ 0 & \text{otherwise} \end{cases}$$

Obtain the original slice $f(x,y)$ using Fourier Slice Theorem. **(8)**

EEL715: Digital Image Processing **Minor I, IInd Sem 2014-15**
Max Marks: 40 **Duration: 1 hour**

Ques 1. Given the following image. The top left pixel corresponds to the coordinate (0,0)

$$\begin{bmatrix} 1 & 1 & 4 & 4 \\ 1 & 1 & 4 & 4 \\ 4 & 4 & 4 & 4 \\ 4 & 4 & 4 & 4 \end{bmatrix}$$

This image is convolved using the following masks (the center pixels correspond to the coordinate (0,0)). Obtain the output image in each case:

a) $\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$ c) $1/9\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ d) $1/16\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$

(10)

Ques 2. Obtain the Fourier Transform of the following filters

a) $\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$ b) $1/16\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$

(3+3)

Ques 3. Explain how optimal notch filtering can be used to remove periodic noise.

(4)

Ques 4. Given the following original and specified histograms (of a 3-bit, 10X6 image), perform histogram specification. Clearly show all the steps and intermediate results.

Original histogram [9 8 7 6 6 7 8 9]
Specified histogram [6 7 8 9 9 8 7 6]

(12)

Ques 5. An image is distorted by the following additive noise: White, Gaussian with zero mean and variance = σ^2. Obtain the characteristics of noise after this image is filtered using the following filters.

a) $1/9\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ b) $\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$

(4+4)