2022

DIGITAL IMAGE PROCESSING

Full Marks – 100

Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer any *five* questions.

1. (a) Describe in one or two sentence the
following terms :   2×3=6

    (i)   Nyquist criteria

    (ii) Fourier trnasform

    (iii) Convolution.

  (b) (i) Draw frequency domain representation
of the following 2D equations :

      $f(x, y) = 2 \sin 2\pi (3x + 4y)$

    (ii) Find the value of a Fourier coefficient
W_8^3.   2+2=4

[Turn over

(c) Find 4-point FFT of the following sequences :

$$x = [2, 3, -2, 4].$$ 　　　4

(d) Perform convolution of the following sequences :

$$x_1 = [2,3,4,5] \wedge x_2 = [4,-1,2,-2]$$ 　6

2. (a) State the differences between spatial and intensity transformation. 　3

(b) Image A of size 40×60 has the top left corner at (5, 5). The image is rotated by 45° anticlockwise with respect to the (0, 0). Find the new coordinates of the four corners after rotation. Is there any change of area in the circle ? 　12

(c) The following image A is low pass filtered with the kernal g. Find the resultant image at the marked pixels. 　5

$$A = \begin{bmatrix} 22 & 34 & 34 & 48 \\ 45 & ㊸ & ㊷ & 34 \\ 128 & ⑫⑨ & ⑫⑧ & 120 \\ 125 & 126 & 126 & 120 \end{bmatrix}$$

$$g = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ -1 & 0 & -1 \end{bmatrix}$$

3. (a) Name any five image enhancement algorithms and write their intensity transformation equations. 2

   (b) An image with the pdf shown in Fig. 3(a) is needed to be converted in an image with pdf as shown in Fig.3(b). Find the transformation function. 10
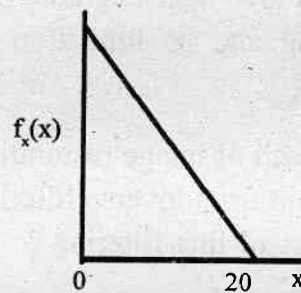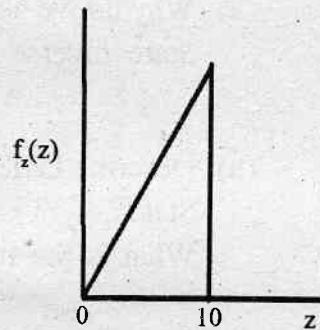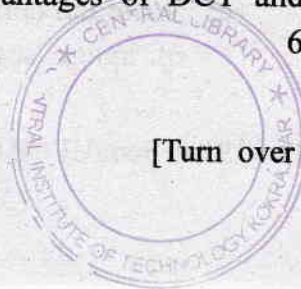

Fig. 3(a)

Fig. 3(b)

   (c) What is unsharp masking ? How it is different from low pass filtering ? 8

4. (a) Deduce the forward and inverse transform equations of DFT, DCT and DHT.

$$2+2+2=6$$

   (b) Deduce 4 point DCT matrix. What are the advantages and disadvantages of DCT and DFT ? 6

106/19/6th Sem/UECE 616A   (3)   [Turn over

(c) Let X be an 8 bit sequence and X = [2,3,4,2,6,7,8,2] which can be split in $X_{even} = (2,4,6,8)$ and $X_{odd} = (3,2,7,2)$. If the Fourier transform of X_{even} and X_{odd} are respectively $F(X_{even}) = [20, -4 + 4j, -4, -4 - 4j]$ and, find F(X).   8

5. (a) Why do we need to study image degradation ? State inverse filtering and its limitation.

2+3=5

(b) Describe LMS approach of image restoration. State how it is different from inverse filtering. What is the limitation of this filtering ?   15

6. (a) State various approaches of image compression. What is run of run length coding. Perform run length coding of the following binary sequence when maximum run is 8 :   8

X = [1 1 1 1 1 1 1 1 1 1 10 0 0 0 0 0 0 0 1 10 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1111].

(b) State region growing segmentation technique.

6

(c) Write the concept of active contour technique of image segmentation.   6

7. Write short notes on any *two* :   10×2=20

   (a) Homorphic filtering

   (b) JPEG

   (c) Anisotropic diffusion filtering

   (d) FFT.