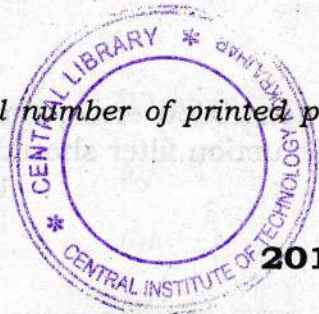


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53 (EC 714) DIPR

2019

DIGITAL IMAGE PROCESSING

Paper : EC 714

Full Marks : 100

Time : Three hours

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

Answer Q. No. 1 and any four from the rest.

1. (i) An image has 256 intensity levels. How many bits are required for storing 1 pixel information? 1
 - (a) 4 bit
 - (b) 1 bit
 - (c) 8 bit
 - (d) 256 bits

Contd.

(ii) For reducing reconstruction error, the order of the reconstruction filter should be— 1

(a) reduced

(b) increased

(c) no relation with the order of the filter

(iii) Two sequences $x_1(n)$ and $x_2(n)$ have lengths 4 and 5 respectively. What would be the length of the sequence $y(n) = x_1(n) * x_2(n)$? 1

(iv) Which of the following transform does not have a separable basis kernel? 1

(a) DFT

(b) DCT

(c) DHT

(d) K-L transform

(v) A 2D DHT kernel has the following shape: 1

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & * \end{bmatrix}$$

What is the value of *?

(a) 1

(b) -1

(c) 0

(d) 1/0

(vi) Which of the following filter enhance edges? 1

(a) High-boost filter

(b) Wiener filter

(c) Ordinarily low-pass filter

(d) Chebyshev high-pass filter

(vii) Which of the following transformation shows best energy conservation properly? 1

(a) DHT

(b) DCT

(c) DFT

(d) FFT

Contd.

(viii) Full form of CT is _____ in medical image processing. (Fill in the blank) 1

(ix) Contrast stretching is an image enhancement technique. (True/False) 1

(x) JPEG is a DCT-based image compression technique. (True/False) 1

(xi) What is the size in KB/MB for an 8-bit image of size 100×100 ? _____ . (Fill in the blank) 2

(xii) Number of multiplication and addition of 16-point DFT are _____ and _____ . (Fill in the blanks) 2

(xiii) Two-point DFT of sequence $[2 \ 3]$ is— 2

(a)
$$\begin{bmatrix} 5 \\ -1 \end{bmatrix}$$

(b)
$$\begin{bmatrix} 2+3j \\ 2-3j \end{bmatrix}$$

(c)
$$\begin{bmatrix} 3+2j \\ 3-2j \end{bmatrix}$$

(d)
$$\begin{bmatrix} 2-3j \\ 2+3j \end{bmatrix}$$

(xiv) Find 2D Hadamard transform of the 2×2 image 2

$$I = \begin{bmatrix} 48 & 42 \\ 12 & 32 \end{bmatrix}$$

(xv) A matrix is defined as $A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$. Find the trace of $A^T A$. 2

2. (a) Discuss 2D sampling theorem with neat sketch of the spectrum before and after sampling. 10

(b) Explain Fast Fourier Transform step-by-step using the following sequence: $x = [1 \ 1 \ 2 \ -3 \ 2]$ 10

3. (a) An image is given below: 10

$$A = \begin{bmatrix} 23 & 20 & 12 \\ 12 & 22 & 12 \\ 8 & 32 & 33 \end{bmatrix}$$

Find its Laplacian. Include a padded row and column in suitable position using reflection.

(b) Perform convolution of the two following sequences : 10

$$x_1(n) = \begin{bmatrix} 1 & 2 & 3 & 4 \\ & & \uparrow & \end{bmatrix}$$

$$x_2(n) = \begin{bmatrix} 1 & 1 & 2 \\ & \uparrow & \end{bmatrix}$$

4. (a) What do you mean by order statistics filter? Name any three order statistics filter and define them in short. $2+2 \times 3=8$

(b) What are the drawbacks of conventional mean filtering? Describe how Edge-preserving smoothing can be obtained. $2+10=12$

5. (a) What are the primary causes of image degradation? How can they be restored? Explain with image degradation model. $2+6=8$

(b) Name a filter which works on the principle of Minimum Mean Square Error (MMSE) approach. Describe image restoration using MMSE approach. $1+11=12$

6. (a) What are applications of image compression? 1

(b) Suggest an image compression technique in case when image histogram is known. 1

(c) Suppose a 3-bit image has the following histogram 8

- $P(0) = .1$ $P(4) = .2$
- $P(1) = .3$ $P(5) = .25$
- $P(2) = .05$ $P(6) = .05$
- $P(3) = .05$ $P(7) = 0$

Apply a suitable entropy coding technique for coding it.

(d) Find the average length of the code and the efficiency. $3+2=5$

(e) Match the following: 5

A	B
(a) Run-length coding	(i) wavelet-based
(b) JPEG	(ii) DCT-based
(c) JPEG-2000	(iii) entropy coding
(d) Huffman Coding	(iv) uses co-variance matrix
(e) K-L transform	(v) suitable for Binary image compression

7. Write short notes on : **(any two)** $10 \times 2 = 20$

(i) Homomorphic filtering

(ii) JPEG

(iii) K-L transform

(iv) Anisotropic diffusion.

(i) Run-length coding	(ii) wavelet-based
(iii) DCT-based	(iv) entropy coding
(v) near-lossless coding	(vi) suitable for binary image compression