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 streaching 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 :
$x = [1\ 2\ -3\ 2]$ 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+2×3=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

$P(0) = \cdot 1$ $P(4) = \cdot 2$

$P(1) = \cdot 3$ $P(5) = \cdot 25$

$P(2) = \cdot 05$ $P(6) = \cdot 05$

$P(3) = \cdot 05$ $P(7) = 0$

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)*** 10×2=20

(i) Homomorphic filtering

(ii) JPEG

(iii) K-L transform

(iv) Anisotropic diffusion.
