Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EC370

Course Name: Digital Image Processing

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks

Marks

1 a) With a neat diagram explain the working of a Vidicon camera tube. (6)

b) Explain the terms (i) Mach-band effect, (ii) Saturation (iii) 8 - adjacency (6)

c) List the properties of distance functions. (3)

2 a) Write the recursive definition of a Hadamard Transform. Using this definition construct a 4 x 4 Hadamard matrix. (4)

b) Bring out the structural difference between circulant and Toeplitz matrices. Write an example for each. (4)

c) What is Singular value decomposition? Explain how each factor in SVD can be found out? (7)

3 a) State and prove the 2-D Sampling theorem. (6)

b) Write the Forward and inverse transformation kernels for 2D-DFT. Are these kernels separable? Justify your answer. (5)

c) Suppose the eigen vectors of covariance matrix of the 2-dimensional data are $e_1 = \begin{pmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{pmatrix}$ and $e_2 = \begin{pmatrix} 1/\sqrt{2} \\ -1/\sqrt{2} \end{pmatrix}$ respectively. If the mean vector of data is zero, find the KL transform of the data point $x = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$ (4)

PART B

Answer any two full questions, each carries 15 marks

4 a) List and describe any two point processing operations with necessary graphs. (5)

b) Consider the following image of size 5x5. It has gray level values from 0-7. Perform the histogram equalization of the image and obtain the final image. (10)

5	5	5	5	5
3	5	7	5	3
3	7	7	7	3
3	5	7	5	3
5	5	5	5	5

5 a) Differentiate between constrained and unconstrained restoration. (3)

b) Explain the image degradation and restoration model. (4)

c) With appropriate equations, explain the issue with inverse filtering for restoring the image. How Wiener filtering eliminates the issue? (8)

6 a) Explain the smoothing of images in frequency domain using (i) ideal low pass filters and (ii) Butterworth low pass filters. (5)

b) Explain the terms unsharp masking and high-boost filtering. (5)

c) How the separation of illumination and reflectance components is achieved in homomorphic filtering? (5)

PART C

Answer any two full questions, each carries 20 marks

7 a) Explain the Region splitting and merging approach for image segmentation. (6)

b) Differentiate between local, global and adaptive thresholding. (6)

c) How Hough transform is helpful in edge linking? (8)

8 a) What are the basic data redundancies exploited in image compression? Explain. (8)

b) Compare the transforms DCT and KLT as a choice for image compression application. (4)

c) Explain the concept of Arithmetic coding. (8)

9 a) Explain any one clustering algorithm for image segmentation. (8)

b) Perform Huffman coding for the following set of symbols. (8)

Symbol	Probability
A	0.2
B	0.1
C	0.05
D	0.6
E	0.05

c) Name and draw any two types of spatial masks used for edge detection. (4)

****

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: EC370

Course Name:Digital Image Processing

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks Marks

1 a) a) An image f(x, y) = 2 cos 2π (3x + 4y) is sampled with sampling intervals Δx = 0.2 and Δy = 0.2 in x and y direction respectively. Determine the (7)

i) Sampled image spectrum

ii) Fourier transform of image after it has been low pass filtered

iii) Reconstructed image.

iv) Will the system produce aliasing error?

b) For the image segment I = $\begin{bmatrix} 2 & 2 \\ 1 & 3 \end{bmatrix}$, compute the transform coefficients using (8)

i) DFT

ii) Haar transform

2 a) State and explain 2D sampling theorem for band limited images. (8)

b) What are orthogonal transforms? Define the energy compaction property of an unitary transform. (7)

3 a) State and prove any two properties of 2D DFT. (6)

b) Explain how colour images are represented using HSI colour space model. (9)

PART B

Answer any two full questions, each carries 15 marks

4 a) Give a short note on geometric transformations. (7)

b) Write the algorithm for computing median of an n x n neighbourhood. (8)

What is the value of middle pixel after applying a i) 3 x 3 median filter and ii) 3 x 3 box filter ?

$$\begin{bmatrix} 1 & 0 & 8 \\ 4 & 4 & 9 \\ 1 & 0 & 0 \end{bmatrix}$$

5 a) Derive the transfer function of Wiener filter. Give the condition in which Wiener filter reduces to an inverse filter. (10)

b) Distinguish between unsharp masking and high boost filtering. (5)

6 a) A 4 x 4 image patch (4 bits/pixel) is given by $I=\begin{bmatrix}12 & 9 & 12 & 10\\ 12 & 14 & 8 & 10\\ 9 & 13 & 12 & 10\\ 12 & 14 & 12 & 10\end{bmatrix}$ (8)

Apply histogram equalization to the image by rounding the resulting image pixels to integers. Sketch the histograms of original image and histogram equalised image.

b) Explain constrained and unconstrained image restoration. (7)

PART C

Answer any two full questions, each carries 20 marks

7 a) Obtain the Huffman code for the word 'IMAGEPROCESSING' and determine its efficiency. (10)

b) Explain how Hough transform can be used to detect lines. (10)

8 a) Discuss the role of derivatives in edge detection. (10)

b) State and explain the state of redundancies in images. (10)

9 a) Explain split and merge procedure in image segmentation. (10)

b) With the help of a block diagram, explain DCT based JPEG compression standard. (10)

****

Reg No.:_____ Name:_____

03000EC370052001

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth semester B.Tech degree examinations (S), September 2020

Course Code: EC370

Course Name: Digital Image Processing

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks Marks

1 a) Explain the term "m-connectivity" with respect to a digital image. (2)

b) Obtain the correlation of the following two matrices using matrix method. (5)

$x(m,n) = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ $h(m,n) = \begin{bmatrix} 3 & 4 \\ 4 & 4 \end{bmatrix}$

c) Compare 2D DFT and DCT of the gray scale image, (8)

$$f(m,n) = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{bmatrix}$$

2 a) Explain the principle of sampling and quantization. Discuss its effect on increasing (i) sampling frequency and (ii) quantization levels of image. (8)

b) With diagram, explain the different colour image models. (7)

3 a) Obtain KL transform basis for the following matrix (8)

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

b) State and prove convolution property and periodicity property of 2D DFT. (7)

PART B

Answer any two full questions, each carries 15 marks

4 a) Derive a Wiener filter for image restoration using minimum mean square approach. Give the condition in which Wiener filter reduces to an inverse filter. (10)

b) Perform histogram equalization of an image shown below: (5)

$$f(m,n) = \begin{bmatrix} 3 & 2 & 4 & 5 \\ 7 & 7 & 8 & 2 \\ 3 & 1 & 2 & 3 \\ 5 & 4 & 6 & 7 \end{bmatrix}$$

5 a) Explain the image restoration model. (5)

b) Explain the different spatial filtering techniques used in images. Distinguish them with appropriate masks. (7)

c) Give the drawbacks of inverse filtering in image restoration. (3)

6 a) Write a short note on Lagrange multipliers. (4)

b) Define homomorphic filtering with necessary equations. (4)

c) What is median filtering? Calculate the median value of underlined pixels given below using a 3×3 mask. (7)

$$f(m,n) = \begin{bmatrix} 12 & 13 & 22 & 26 & 32 & 24 \\ 34 & \underline{123} & \underline{24} & \underline{100} & \underline{34} & 22 \\ 14 & 15 & 13 & 32 & 31 & 21 \end{bmatrix}$$

PART C

Answer any two full questions, each carries 20 marks

7 a) Explain the region based approaches to image processing. (10)

b) Explain any DCT based image compression scheme. Compare the same with Wavelet based image compression method. (10)

8 a) An information source produces sequences of independent symbols *A,B,C,D,E,F,G* with corresponding probability1/3, 1/27, 1/3, 1/9, 1/9, 1/27 & 1/27. Construct a binary code using Huffman coding algorithm. (5)

b) Explain how the wavelet transform can be used for image compression. (5)

c) Construct arithmetic coding to encode and decode the word "INDIA". (10)

9 a) Explain the methods of thresholding for image segmentation. (6)

b) Explain edge detection using gradient operator. Explain edge linking using Hough transform. (10)

c) Segment the data sets (4,6), (5,10), (8,9), (3,9), (2,8), (8,4), (5,1) and (4,2) into two clusters based on K means algorithm with initial sets as (3, 9) and (8, 4). (4)

****