BArch / MBA / MCA / M Tech / M Sc (Res) / Ph.D. Course / Branch: Instrumentation Technology Sem: VII

Sub: Image Processing (Elective)

Code: I T 6 D 1 Duration of Paper: 3 22 Hrs. Maximum Marks: 100

To Candidates: (Shall include instruction regarding issue of Hand book / Charts / Tables etc.)

Answer any FIVE full questions.

Note: Please do not write on back side pages

	Marks
Discuss the elements of digital image processing system.	-08-
Explain a simple image model	-04-
Explain the following relationships between the pixels. (i) connectivity (ii) Distance measures	-08-
Explain sharpening filters used in image enhancement	-12-
With the help of a block diagram explain the image enhancement based on image model. point processing	-08-
Define histogram of an image. Explain histogram specification.	-10-
Define the terms forward transformation kernel and inverse transformation kernel. Explain how a digital image can be completely recovered from its transform with seperable kernels.	-10-

Marks

Explain the following properties of the two-dimensional fourier transform. -12-

(i) Seperability
(ii) Periodicity & conjugate Symmetry
(iii) Translation
(iv) Average value & Laplacian

) Explain Discrete Cosine transform. -03-

) Discuss briefly about the diagonalization of circulant matrix. -1

) Explain how a wiener filter can be used for the restoration of a degraded image. -10-

) Define Image Segmentation. Explain the basic principle of edge detection. -10-

) Explain the optimal thresholding technique in Image Segmentation. -10-

) Briefly discuss about the region Splitting and merging in image segmentation. -10

) Explain the terms -10

(i) Coding Redundancy
(ii) Interpixel Redundancy

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With the block diagram explain the elements of image compression System model.

Discuss briefly about the Huffman coding in image compression.

EC/TE6D4

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Sixth Semester B.E. Degree Examination, January/February 2004

Electronics and Communication/Telecommunication Engineering

Image Processing

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Explain the process of formation of a digital image and hence give its representation. (10 Marks)

   (b) Explain the various relationships between pixels. (10 Marks)

2. (a) Explain the different distance measures as applied to a digital image. (6 Marks)

   (b) What is histogram? Give an algorithm for obtaining the histogram of a digital image. (6 Marks)

   (c) How is a binary image obtained. List the different operators applied to a binary image. (8 Marks)

3. (a) Prove the following properties of 2D discrete Fourier transform

   i) Separability ii) Periodicity and conjugate symmetry. (8 Marks)

   (b) Give an expression for 2D discrete cosine transform. Where is it used and why such a transform normally is selected. (4 Marks)

   (c) Show that the Fourier transform of the convolution of two functions is the product of their Fourier transform. (8 Marks)

4. (a) Give an expression for 2D Hadamard transform pair. Draw the ordered Hadamard basis function for N=4. (10 Marks)

   (b) Obtain the slant transform matrix for N=8. (10 Marks)

5. (a) Explain the various gray level transformations used for image enhancement. (10 Marks)

   (b) Develop a procedure for computing the median of an n×n neighborhood. (10 Marks)

6. (a) Consider a binary image of size N×N pixels that contains a square of i's of size n×x pixels at its center. The rest of the pixels in this image are background pixels labelled '0'. Sketch the gradient of the image using.

   a) Sobel operator

   b) Laplacian operator (10 Marks)

   (b) Explain YIQ and HSI color model as applied to image. (10 Marks)

7. (a) What is image restoration and how does it differ from image enhancement. (4 Marks)

Contd.... 2

(b) Explain the degradation model for a 2D discrete function. (8 Marks)

(c) Explain the unconstrained restoration technique in improving a degraded image. (6 Marks)

8. Write short note on :

a) Wiener filter

b) Frequency domain method of image enhancement

c) Steps in digital image processing

d) Hotelling transform. (5 × 4=20 Marks)

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Sixth Semester B.E. Degree Examination, July/August 2004

Instrumentation Technology

Digital Image Processing

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. All questions carry equal marks.

1. (a) Explain elements of digital image processing system with the help of a block diagram. (8 Marks)

   (b) Mention different applications of DIP. (3 Marks)

   (c) Explain uniform and nonuniform sampling. (5 Marks)

   (d) Define the following terms :
   i) Weber's ratio ii) Brightness adoptation. (4 Marks)

2. (a) Explain connectivity and distance measures with suitable examples as applied to DIP. (5 Marks)

   (b) What is hystogram? Explain how hystogram equalization enhances the quality of image. (10 Marks)

   (c) Explain image enhancement in the frequency domain. (5 Marks)

3. (a) Explain spatial domain methods of image enhancement. (10 Marks)

   (b) Explain homomorphic filtering with block diagram. List its advantages. (5 Marks)

   (c) Write short notes on 2-D transformation kernel. (5 Marks)

4. (a) Explain the following properties of 2-D Fourier transformation (8 Marks)
   i) Translation ii) Rotation
   iii) Distributivity and scaling iv) Seperability

   (b) Explain Harr transform and Hadmard transforms with their properties. (12 Mark

5. (a) Explain degradation model with the help of block diagram. (8 Mark

   (b) Mention and explain different approximation of degradation. (4 Mark

   (c) Explain inverse filter and its role in restoring the image. (8 Mar

6. (a) Explain different edge detection operators and their usefulness in image segmentation (10 Ma

   (b) Give the fundamental relationships used for image segmentation. Explain region splitt and merging with suitable examples. (10 Ma

Contd.

IT6D1

7. (a) Explain image segmentation using thresholding. (6 Marks)

   (b) Write short notes on frequency domain approach in image segmentation. (4 Marks)

   (c) Define the term image compression. Also discuss the following :
   i) Coding redundancy ii) Fidelity criterion. (10 Marks)

8. (a) With the help of block diagram explain the basics of data compression. (6 Marks)

   (b) Explain error free compression model with the help of block diagram. Explain any one method. (7 Marks)

   (c) Explain lossy compression model with the help of block diagram. Explain any one method. (7 Marks)

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NEW SCHEME

Seventh Semester B.E. Degree Examination, Dec.06/Jan. 07
EC / TC
Image Processing

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Assume missing data if any appropriately for numerical questions.

1 a. With a neat block diagram, explain the fundamental steps in digital image processing. **(07 Marks)**

b. Explain the following term as applicable to image processing with necessary graphs. i) Cones and Rods ii) Brightness adaptation iii) Isopreference **(06 Marks)**

c. Discuss the basic concepts of sampling and quantization by considering an example of a continuous image. **(07 Marks)**

2 a. Explain with necessary equations i) Adjacency ii) Distant measures which exhibits basic relationships between the pixels in an image. **(06 Marks)**

b. For a given orthogonal matrix A and image U

$$A = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \qquad U = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

Obtain i) Transformed image. ii) Originai image from transformed image. **(06 Marks)**

c. Show that the variances of the transform coefficients can be written as a separable product i.e. $\sigma_v^2(K,l) = \sigma_1^2(K) - \sigma_2^2(l)$ **(08 Marks)**

3 a. Discuss in brief the properties of one – dimensional discrete Fourier transforms (DFT) / unitary discrete Fourier transforms (unitary DFT). **(06 Marks)**

b. Define the discrete cosine transform with relevant expressions and explain the properties of cosine transforms in brief. **(08 Marks)**

c. Given H_1 – the core matriy as $H_1 = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$, derive the expression for H_3 assuming n = 3. Also indicate its sequency. **(06 Marks)**

4 a. Show that the average mean square error between the sequences u(n) and Z(n) Jm is minimum when $A = \phi^{*T}$; $B = \phi$; $AB = I$. for the following KL transform basin restriction **(07 Marks)**

Contd....2

b. With the help of graphical interpretation, explain some basic gray level transformations used for image enhancement. (07 Marks)
c. Explain the following terms with respect to image enhancement
i) Contrast stretching ii) Gray – level slicing (06 Marks)

a. Explain the concept of Histogram matching, development of the method and the corresponding implementation with a suitable example. (06 Marks)
b. For a 3 × 3 mask, explain the mechanics of linear spatial filtering with necessary equations. (08 Marks)
c. Using the magnitude of the gradient, explain the use of first derivatives for image enhancement by taking a 3 × 3 region of image. (06 Marks)

a. With the help of a neat block diagram, explain the Homomorphic filtering approaching for image enhancement process. (10 Marks)
b. With necessary expressions, explain the periodic noise reduction by frequency domain filtering with respect to notch filter. (10 Marks)

7 a. Briefly explain the linear position invariant degradation employed for image restoration. (06 Marks)
b. Discuss the minimum mean square error (Wiener) filtering that incorporates both the degradation function and the statistical characteristics of noise into the restoration process. (08 Marks)
c. With respect to image restoration explain i) Spatial transformation ii) Gray level interpolation. (06 Marks)

a. With relevant probability density function, explain
i) Raleigh Noise ii) Erlang (Gamma) Noise iii) Uniform Noise. (06 Marks)
b. Explain with necessary expression, the procedure for converting colours from RGB to HIS and vice versa. (06 Marks)
c. With a neat functional block diagram, explain the pseudo color image processing. Comment on pseudo color coding approaches. (08 Marks)

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EC762

Seventh Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Image Processing

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. With a neat block diagram, describe various components used in general purpose image processing system. (08 Marks)
b. Describe briefly the principle of image formation in the human eye. (06 Marks)
c. How the image acquisition is done using a single sensor. (06 Marks)

2 a. Explain the role of sampling and quantization in image processing system. (08 Marks)
b. Define different types of adjacency and explain how m – adjacency in different from 8 – adjacency with an example. (06 Marks)
c. Calculate the number of bits required to store a digital image of size 1024×1024 pixels and the number of gray levels are 128. (06 Marks)

3 a. For the 2×2 transform A and the image U (07 Marks)

$$A = \frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \quad \text{and} \quad U = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

Calculate the transformed image V and the basis images.
b. Give briefly any five properties of 2 dimensional DFT. (05 Marks)
c. Construct Haar transform matrix of N = 4. (08 Marks)

4 a. Give the expression for Hadamard transform and generate the corresponding 1 – D Kernel for N = 4. Explain any of its two properties. (12 Marks)
b. Highlight the useful expressions of discrete cosine transform and discuss its properties. (08 Marks)

5 a. Explain the basic concept of any two methods of piecewise linear transformation functions used in image enhancement. (06 Marks)
b. Develop a procedure to perform histogram matching. (08 Marks)
c. How the following spatial filters are important in image enhancement? Explain i) Smoothing filter ii) median filter. (06 Marks)

6 a. How are various filter masks are generated to sharpen images in spatial filter. (10 Marks)
b. With block diagram, analyze homomorphic filtering approach in the image enhancement. (10 Marks)

7 a. What are the important noise probability density functions are analyzed in the restoration process? Explain. (10 Marks)
b. Discuss various mean filters and order statistics filters in the image restoration system. (10 Marks)

8 a. Write short notes on: i) Weiner filtering and ii) Inverse filtering. (10 Marks)
b. Explain in detail Pseudo colour image processing. (10 Marks)

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EC762

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NEW SCHEME

Seventh Semester B.E. Degree Examination, May 2007
EC/TC
Image Processing

Time: 3 hrs.] [Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Draw neat diagrams/waveforms wherever necessary.
3. Assume suitably for any missing data.

1 a. In connection with image processing system state:
i) Important application areas where image processing is essential.
ii) Components of an image processing system. **(10 Marks)**

b. What is image sampling and quantization? What are the different parameters which will decide the number of storage bits of the image in the discrete domain? **(10 Marks)**

2 a. What are the basic relationships between pixels? With neat diagrams and appropriate mathematical expressions explain:
i) Neighbours ii) Adjacency iii) Connectivity. **(10 Marks)**

b. For pixels p, q with co-ordinates (x, y) and (s, t) respectively find the distance metric D for the following cases: i) Euclidean distance D_e (p, q)
ii) City block distance D_4 (p, q) iii) Chessboard distance D_8 (p, q). **(05 Marks)**

c. Find the time required in seconds for transmitting a monochrome binary image having size 2.5" X 2" scanned at 150 DPI to be sent at 28 kbps speed. **(05 Marks)**

3 a. Define Walsh transformation. Generate the corresponding 1 D kernel for N = 4. Find the transform W(u) for a given four point sequence f(x). Also find odd and even parts. **(10 Marks)**

b. With respect to 2D discrete Fourier Transform of an image explain the following, derive suitable equations:
i) Separability ii) Translation iii) Rotation iv) Periodicity. **(10 Marks)**

4 a. What are the different spatial domain techniques for image enhancement? **(02 Marks)**

b. Considering the basic gray level transformation of pixels, explain:
i) Contrast stretching ii) Gray level slicing iii) Bit plane slicing. **(10 Marks)**

c. Write an explanatory note on Histogram Equalization. **(08 Marks)**

5 a. What are the basic steps for image filtering in frequency domain? Explain with a block diagram. **(10 Marks)**

b. Illustrate homomorphic filtering approach for image enhancement. Derive the suitable result. **(10 Marks)**

6 a. What is the purpose of image restoration? Explain the model of image degradation and restoration process using suitable block diagram. **(10 Marks)**

b. Explain how image degradation is carried out using:
i) Observation ii) Experiment iii) Mathematical modeling. **(10 Marks)**

7 a. With relevant mathematical expression, explain how a Wiener filter achieves restoration of a given degraded image. **(10 Marks)**

b. What is geometric transformation? Explain how image restoration is achieved through: i) Spatial Transformation ii) Gray level transformation. **(10 Marks)**

8 a. Discuss briefly any two colour model used in colour image processing. **(10 Marks)**

b. Develop a scheme for converting colours from:
i) RGB to HSI ii) HSI to RGB. **(10 Marks)**

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EC762

Seventh Semester B.E. Degree Examination, Dec.08/Jan.09
Image Processing

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Standard notations are used.
3. Missing data may be suitably used.
4. Draw neat diagram wherever necessary.

1 a. With a neat block diagram, explain the fundamental steps is digital image processing. (12 Marks)

b. Explain various Image sensing and acquisition methods. (08 Marks)

2 a. Explain the formulation of digital image model by sampling and quantization. (10 Marks)

b. Consider the image segment shown below:

i) Let V = {0, 1} and compute the length of the shortest 4, 8 and m-path between p and q. If a particular path does not exist between these two points. Explain why.

ii) Repeat for V = {1, 2}. (10 Marks)

3	1	2	1	(q)
2	2	0	2	
1	2	1	1	
1	0	1	2	

(p)

3 a. For the given orthogonal matrix A and image U, determine transformed image, basis image and inverse transformation of the image: $A = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$ $U = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$. (10 Marks)

b. Define Hadamard transform and Haar transform for N = 4. (10 Marks)

4 a. The histogram of the 8 level of size 64 x 64 is shown in Fig.Q.4(a). Draw the histogram of the equalized image. (10 Marks)

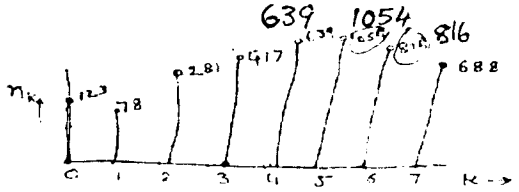

Fig.Q.4(a).

b. Explain histogram specification method for image enhancement. (10 Marks)

5 a. What is high – boost filtering? Explain, how high-boost filtering increases the enhancement of the image. (10 Marks)

b. Explain different smoothing frequency domain filters. (10 Marks)

6 a. Define the process of restoration. Explain the order statistics filter for restoring images in the presence of noise. (10 Marks)

b. With relevant mathematics expressions, explain how a wiener filter achieves restoration of a given degraded image. (10 Marks)

7 a. Bring out the use of Geometric transformation for image restoration? (10 Marks)

b. Explain Pseudocolour image processing with a neat functional diagram. (10 Marks)

8 Write short notes on:

a. Gamma correction. (07 Marks)

b. Homomorphic filter. (07 Marks)

c. Brightness adaptation. (06 Marks)

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EC762

Seventh Semester B.E. Degree Examination, May / June 08
Image Processing

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Assume missing data, if any, appropriately.

1 a. With the help of a neat block diagram, explain the components of a general purpose image processing system. (12 Marks)
b. Explain Microdensitometer type of image acquisition system. (08 Marks)

2 a. Explain any two methods used for digital image zooming and shrinking. (08 Marks)
b. Let p and q are the pixels at coordinates (10,12) and (15,20) respectively. Find out which distance measure gives the minimum distance between them. (06 Marks)
c. Explain the following : i) Aliasing and Moire patterns ii) Weber ratio iii) Illumination and reflectance model of the image. (06 Marks)

3 a. Give an expression for Discrete Cosine Transform and its inverse for a sequence f(x). Explain the properties. (08 Marks)
b. What are image transforms? List a few. (04 Marks)
c. Generate the Hadamard transform matrix H_n for n = 2 from the core matrix $H_1 = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$ and indicate its sequency. (08 Marks)

4 a. Explain in brief the following as applied to the Discrete Fourier Transform.
i) Convolution theorem iii) Conjugate symmetry and
ii) Periodicity iv) Separability (12 Marks)
b. Show that the Laplacian can be implemented in the frequency domain by using filter.
$H(u,v) = -\left[(u - M/2)^2 + (v - N/2)^2\right]$ (08 Marks)

5 a. Explain image enhancement using Arithmetic and Logic operations. (08 Marks)
b. Why smoothing is needed in image processing and what is its effect on the image? Explain an Ideal LPF and Butterworth LPF in the above context. (12 Marks)

6 a. With the help of neat graphical illustrations, explain the Power – law transformation and Piecewise linear contrast stretch. (10 Marks)
b. With the relevant p.d.f plots, explain : i) Gaussian noise, ii) Impulse noise. (06 Marks)
c. What are the applications of the second order derivative in image processing? (04 Marks)

7 a. Explain in brief the Inverse filtering approach and its limitation in image restoration. (04 Marks)
b. What is Order – statistics filter? Explain any two. Compare their relative merits and demerits. (08 Marks)
c. With the help of a block diagram, explain the Image Degradation and Restoration model and mention the reasons for degradation. (08 Marks)

8 a. Explain in brief, the properties of a Linear, Position invariant operator. (04 Marks)
b. Write a note on the RGB Colour model with neat sketches. (08 Marks)
c. Write a note on Intensity slicing as applied to pseudocolour image processing. (08 Marks)

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06EC756

Seventh Semester B.E. Degree Examination, Dec.09/Jan.10
Image Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is digital image processing? Explain the fundamental steps in digital image processing. **(10 Marks)**

b. How is image formed in an eye? Explain the importance of brightness adaptation and discrimination in image processing. **(10 Marks)**

2 a. Explain the concept of sampling and quantization of an image. **(08 Marks)**

b. Explain :
i) False contouring ii) Checkerboard pattern **(06 Marks)**

c. How is image acquired using a single sensor? Discuss. **(06 Marks)**

3 a. Explain any four properties of two-dimensional Fourier transforms. **(08 Marks)**

b. Define two-dimensional unitary transform. Check whether the unitary DFT matrix is unitary or not for N = 4. **(06 Marks)**

c. For the 2 x 2 transform A and the image U

$$A = \frac{1}{1}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \quad \text{and} \quad U = \begin{bmatrix} 1 & 2 \\ 8 & 4 \end{bmatrix}$$

Calculate the transformed image V and the basis images. **(06 Marks)**

4 a. Construct Haar transform matrix for N = 2. **(12 Marks)**

b. Explain the importance of discrete cosine transform, with its properties. **(08 Marks)**

PART – B

5 a. What is the importance of image enhancement in image processing? Explain in brief any two point processing techniques implemented in image processing. **(10 Marks)**

b. Highlight the importance of histograms in image processing and develop a procedure to perform histogram equalization. **(10 Marks)**

6 a. Explain the basic concept of spatial filtering in image enhancement and hence explain the importance of smoothing filters and median filters. **(10 Marks)**

b. Explain with block diagram, homomorphic filters in image enhancement. **(10 Marks)**

7 a. Explain the importance of image restoration process in image processing. Explain any four important noise probability density functions. **(10 Marks)**

b. Discuss the importance of adaptive filters in image restoration system. Highlight the working of adaptive median filters. **(10 Marks)**

8 a. Write short notes on:
i) Wiener filtering ii) Inverse filtering **(10 Marks)**

b. Write the steps involved in converting colours from RGB to HSI and vice-versa. **(06 Marks)**

c. Explain pseudocolor image processing, in brief. **(04 Marks)**

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