`7. **SUBJECT DETAILS**

7.6 DIGITAL IMAGE PROCESSING

7.6.1 Objectives and Relevance

7.6.2 Scope of the Subject

7.6.3 Prerequisites

7.6.4 Syllabus

i. JNTU

ii. GATE

iii. IES

7.6.5 Suggested Books

7.6.6 Websites

7.6.7 Expert Details

7.6.8 Journals

7.6.9 Findings & Developments

7.6.10 Session Plan

7.6.11 Question Bank (Unit-wise)

i. JNTU

ii. GATE

iii. IES

.6.1 OBJECTIVE AND RELEVANCE

The main objective of this course is to provide an introduction to basic concepts and methodologies for Digital Image Processing, and to develop a foundation that can be used as the basis for further study and research in this field.

During the past 5yrs, there has been a significant increase in the level of interest in image morphology, neural networks, full-color-image processing, image data compression and knowledge based image analysis systems. These form the core of a major modernization effort that resulted in the current 3rd generation book.

This course presents various image processing techniques like image enhancement, Restoration, compression, segmentation, transforms. It gives a better understanding of various monochrome image processing algorithms.

The Digital Image Processing can be processing through new techniques like Wavelet transforms, JPEG 2000 and MPEG.

7.6.2 SCOPE OF THE SUBJECT

New discussion on binary and gray scale image morphology, neural network and full color image processing. The principal objectives of the subject is to provide an introduction to basic concepts and methodologies for digital image processing and to develop a foundation that can be used as the basis for further study and research in the field. It gives the students the opportunity to implement and test with real data of the concepts and algorithms developed in the class.

The ideal environment for this is provided by an image processing system that includes as image digitizer, a general purpose computer and image display equipment. Few techniques lend themselves to straight forward implementation in almost any computer language. New techniques can be learn in this subject like wavelet transform and fast fourier transforms.

7.6.3 PREREQUISITES

Knowledge about mathematical analysis, matrix theory, probability and concepts of digital signal processing is required. Knowledge about signal analysis concepts like correlation, fourier description, algorithms of signal processing, time averaging concepts, algebraic techniques, transform techniques, basics of information theory, discrete transforms, computer programming so as to understand Haar transforms, principal features enhancement by spatial and transform techniques concepts.

7.6.4.1 SYLLABUS - JNTU

UNIT – I
DIGITAL IMAGE FUNDAMENTALS & IMAGE TRANSFORMS

OBJECTIVE:
This topic is connected with components of an area of interest in binary image processing for automation, document imaging and character recognition and the image transforms deals primarily with the development of two dimensional (2D) transforms and their properties.

SYLLABUS:

Digital Image Fundamentals & Image Transforms: Digital Image fundamentals, Sampling and Quantization, Relationship between pixels, Image transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine transform, Hotelling transform

UNIT – II
IMAGE ENHANCEMENT (SPATIAL DOMAIN)

OBJECTIVE:

It deals with Image enhancement by using spatial domain techniques such as point processing, histogram processing and spatial filtering.

SYLLABUS:

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in spatial domain, Enhancement through point operation, types of point operation, histogram manipulation, linear and non-linear gray level transformation, local or neighborhood operation, median filter, spatial domain high-pass filtering

UNIT – III
IMAGE ENHANCEMENT (FREQUENCY DOMAIN)

OBJECTIVE:

It deals with Image enhancement by using frequency domain techniques such as filtering and homomorphic systems.

SYLLABUS:

Image Enhancement (Frequency Domain): Filtering in frequency domain, obtaining frequency domain filters from spatial filters, generating filters directly in the frequency domain. Low pass (smoothing) and High pass (sharpening) filters in frequency domain.

UNIT – IV
IMAGE RESTORATION

OBJECTIVE:

It deals with a formulation of the image restoration problem in the frame work of linear algebra and the subsequent simplification of algebra solutions based on the properties of circuilant and block circuilant matrices.

SYLLABUS:

Image Restoration: Degradation model, Algebrain approach to restoration, inverse filtering, least mean square filters. Constrained least square restoration, interactive restoration.

UNIT – V
IMAGE SEGMENTATION

OBJECTIVE:

It deals with subdivides and image into its constituent parts or objects by using thresholding and region oriented segmentation methods.

SYLLABUS:

Image segmentation: Detection of discontinuities, Edge linking and boundary detection, Threshold, Region oriented segmentation.

UNIT – VI
IMAGE COMPRESSION

OBJECTIVE:
It deals with more applicable basic information theory compression methods of images and these would become the topic of an area with active commercial interest

SYLLABUS:
Image Compression: Redundancies and their removal methods. Fidelity criteria, Image compression models, Source encoder and decoder, Error free compression, Lossy Compression, JPEG 2000 Standards.

UNIT – VII
WAVELET BASED IMAGE PROCESSING

OBJECTIVE:
It deals with the wavelet classification, wavelet image compression and wavelet based denoising methods.

SYLLABUS:
Wavelet based Image processing: Introduction to wavelet transform continuous wavelet Transform, Discrete Wavelet Transforms. Filter banks, Wavelet based Image compression, Wavelet based demising and wavelet thresholding methods.

UNIT – VIII
MORPHOLOGICAL IMAGE PROCESSING

OBJECTIVE:
It deals with binary images and extracting image components that are useful in the representation and description of shapes.

SYLLABUS:
Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, the Strel function, Erosion. Combining Dilation and Erosion: Opening Watermarking methods.

7.6.4.2 SYLLABUS - GATE

Not included

7.6.4.3 SYLLABUS - IES

Not included

7.6.5 SUGGESTED BOOKS

TEXT BOOKS

T1. Digital Image Processing , Rafael C. Gonzalez, Richard E. Woods, 3rd Edn, Pearson, 2008
T2. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2010

REFERENCE BOOKS

R1. Digital Image Processing using MAT LAB, Rafael, C. Gonzalez, Richard E woods and Stens L Eddings, 2nd Edn, TMH, 2010
R2. Fundamentals of Digital Image Processing, A.K. Jain, PHI, 1989.

R3. Digital Image Processing and Computer Vision, Somka, Hlavac, Boyle, Cengage Learning (India Edition) 2008.
R4. Introductory Computer vision Imaging Techniques and Solutions, Adrain Low, 2nd Edn, 2008.
R5. Introduction to Image Processing & Analysis - John C. Russ, J. Christian Russ, CRC Press, 2010.
R6. Wavelet Transforms (Introduction to theory and applications), Raghuveer M. Rao and Ajit S. Bopardikar, Pearson, 2000

7.6.6 WEBSITES

1. www.imageprocessingplace.com
2. http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur
3. www.stanford.edu/class/ee368/
4. www.wikipedia.org
5. www.nptel.iitm.ac.in
6. http://dipl.ee.uct.ac.za
7. http://www.ncc.com/ncc/ipt
8. http://ipl.rpi.edu
9. http://atlsi.com
10. http://www.aw.com/cp

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7.6.8 JOURNALS

1. IEEE Transactions on Image Processing
2. Data Quest
3. IEEE Transactions on Signal Processing
4. IEEE Transactions on Pattern Recognition
5. IEEE Spectrum
6. Journal on Real Time Image Processing

7.6.9 FINDINGS AND DEVELOPMENTS

1. Adapted algorithm for speckle noise reduction for feature extraction and tissue characterization form medical ultrasound images, Kinita B Vandara & Dr. G.R. Kulkarni, IJ-ETA-ETS, Jan.-June 2014, Vol. 7, Issue no.1, Page no. 63-69.

2. Performance Analysis of Secure Medical Image Communication with Digital Signature and Reversible Watermarking, ICTACT Journal on Image and Video Processing, Aug. 2013, Vol. 4, Issue no.1, Page no. 642-646.

3. A Wavelet Transform based Watermarking Algorithm for protecting Copyrights of Digital Images, Divya A & Priya H K, ICTACT Journal on Image and Video Processing, Aug. 2013, Vol. 4, Issue no.1, Page no. 657-660.

4. Removal of implulse Noise Using Weighted Fuzzy Mean Filter Based on Cloud Model, ICTACT Journal on Image and Video Processing, Aug. 2013, Vol. 4, Issue no.1, Page no. 661-666.

5. Wavelet Domain Blur Invariants for Image Analysis, I. Makaremi and M. Ahmadi, IEEE Transaction on Image Processing, Mar. 2012, Vol.21, Issue no. 2, Page no.1348-1356.

7.6.10 SESSION PLAN

7.6.11 QUESTION BANK (Unit-wise)

UNIT-I

1. i. Discuss about the adjacencies available among pixels. **(Nov 13)**
   ii. Derive the kernel for N=4 for Walsh transform.

2. i. Explain the fundamental steps involved in a typical digital image processing.
   ii. Explain the following relationships between pixels: connectivity, distance measures. **(Dec 12)**

3. i. Explain the statement that Fourier transform is viewed as a \mathematical prism".
   ii. Get the expressions for magnitude spectrum, phase spectrum and power spectrum of Fourier transform. **(Dec 11)**

4. i. What is a Image Formation Model.
   ii. Write about Various Image Observation Models with Examples. **(Dec 11)**

5. Consider the image segment shown below

   i. Let V = {0,1} and compute the D4, D8 and Dm distances between p and q
   ii. Repeat for V = {1,2} **(Dec 11)**

6. i. Define sequency.
   ii. Discuss modified Hadamard transform. **(Dec 11)**

7. Develop an algorithm for converting a one pixel thick, 8-connected path to 4-connected path. **(Dec 11)**

8. Explain the following properties of 2D-Fourier Transform:
   i. Distributives and scaling
   ii. Rotation
   iii. Periodicity and conjugate symmetry
   iv. Seperability. **(Dec 11)**

9. Derive transformation matrices for
   i. Translation
   ii. Scaling
   iii. Rotation about X-axis. **(Dec 11)**

10. Does fast algorithm is applicable for computation Hadamard transform, if so what are the problems encountered in implementation. **(Dec 11)**

11. Obtain Slant transform matrix for N=8. **(Dec 11)**

12. What is Sparse Matrix? How it is used by Hough Transform? Explain. **(Dec 11)**

13. Explain the following:
    i. Arithmetic operations on Images

ii. Logical operations on Images. **(Dec 11)**

14. i. Develop a procedure for computing the median of an nxn neighborhood.
    ii. Propose a technique for updating the median as the center of the neighborhood is moved from pixel to pixel. **(Dec 11)**

15. i. Discuss the fundamental steps of Image Processing. **(Dec 11)**
    iii. What is the need of sampling and quantization? Discuss about the relationship between the pixels.

16. i. Discuss the computation of the 2-D Fourier transform as a series of 1-D transforms. Give an example.
    ii. Describe forward transformation kernel of 2-D Walsh Transform. **(Dec 11)**

17. Write short notes on the following: Image geometry. **(Dec 11)**

18. With mathematical expressions discuss Haar transform and explain how it is useful in Image processing. **(May 10)**
19. What is Noise? What are the spatial and frequency properties of noise? **(May 10)**

20. i. Discuss basic transformations of Pixels.
    ii. Define concactenation. **(May 10)**

21. Obtain the total number of additions and multiplications needed for 1-DFFT 2-D FFT. **(May 10)**

22. Derive transformation matrices for
    i. Translation
    ii. Scaling
    iii. Rotation about X-axis. **(May 10)**

23. Propose a technique for detecting gaps of length ranging between 1 and L pixels in line segment of a binary image. Assume that the lines are 1 pixel thick.
    Note: base your technique on 8- neighbour connectivity analysis. **(May 10)**

24. Does fast algorithm is applicable for computation Hadamard transform, if so what are the problems encountered in implementation **(May 10)**

25. Give the expressions for 1D and 2D kernels of Walsh transform, also give the transform expression. **(May 10)**

26. i. What are the applications of digital image processing?
    ii. What are the fundamental steps in image processing? Explain each with a block diagram. **(Nov 08)**

27. i. Obtain the slaut transform matrix for N=4
    ii. What are the applications of Hotlling transform? Explain briefly. **(Nov 08)**

28. i. What are the components required to form an image? Give the model of an image in terms of these components and what is the range and typical values of these components? What is gray-level and gray scale of an image?
    ii. Define various distance measures and connectivity relationships. **(Nov 08)**

29. i. In what way Hotelling transform is different to other transforms? What are th salient features of Hotelling transformer?
    ii. Show that the 1-D DFT and its inverse are periodic functions. **(Nov 08)**

30. i. What are the transformations used in imaging ? Explain them.
    ii. Explain about perspective transformations. **(Nov 08)**

31. i. What is separable transformer? Is D2-D DFT is seperable? Prove it
    ii. Consider a random vector
    $X=[X_1 X_2 X_3 X_4]$
    Where $X_1= (1,1,0)^T$, $X_2 =(0,1,1)^1$, $X_3 =(0,1,0)^T$ and $X_4 =(0,0, 1)^T$ obtain the matrix A whose rows are obtained from the eight vectors of C_X, covariance matrix of X. **(Nov 08)**

32. Show that the D4 distance between two points P and q is equal to the shortest 4-path between these points. Is this path unique? **(Nov 08)**

33. i. Find Fourier transform 2-D sinusoidal function $n(x,y) = A \sin (u_0 x + v_0 y)$
    ii. Obtain the spectrum in above case. **(Nov 08)**

34. i. Discuss the dynamic range compression property w.r.t 2D -DFT.
    ii. State and prove separability property of 2D-DFT. **(Nov 08)**

35. i. Compare with suitable examples the continuous and discrete convolution.
    ii. What iso meant by correlation? Explain the Average value and laplacian of 2D function. **(Nov 08)**

36. i. Distinguish between gray level image and binary image. Discuss the effect on the image resolution with respect to increase in the gray levels.
    ii. What is meant by image sampling? How can you judge the number of sample required for good approximation of an image? **(Nov 08)**

37. i. What is meant by connectivity among pixels? Explain about 4-Connectivity, 8-connectivity with suitable examples.
    ii. What is meant by an equivalence relation? Give an example for it. **(Nov 08)**

38. i. Explain the Translation properties of fourier transform pair.
    ii. Discuss with suitable examples of the periodicity and conjugate symmetry properties of the discrete fourier transform. **(Nov 08)**

39. Explain in detail the following concepts:
    i. Uniform sampling and quantization
    ii. Nonunifiorm sampling and quantization. **(Nov 08)**

40. i. What is m-connectivity among pixels? Give an example.
    ii. State and explain with suitable examples the arithmetic/ logic operations among pixels. **(Nov 08)**

41. Write short notes on:
    i. Pixel neighbours.
    ii. Pixel connectivity.
    iii. Distance measure.
    iv. Equivalence of pixels. **(Dec 09)**

UNIT-II

1. i What is point processing? Explain how it improves image enhancement? **(Nov 13)**
    ii. Explain histogram specification method for image enhancement.

2. i. Suppose that a digital image is subjects to histogram equalization. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.
   ii. Explain the term contrast stretching. **(Dec 12)**

3. i. Give the algorithm for histogram equalization.
   ii. What is the histogram distribution for high contrast, low contrast images. **(Dec 11)**

4. What is histogram of an Image? Sketch histograms of basic Image types. Discuss how histogram is useful for Image enhancement. **(Dec 11)**

5. What are the techniques used for image smoothing? Explain any two techniques of Spatial domain used for smoothing the image. **(Dec 11)**

6. Discuss the following intensity transformations.
   i. Image negatives
   ii. Contrast stretching
   iii. Compression of dynamic range. **(Dec 11)**

7. Explain the following Order-Statistics Filters.
   i. Max and min filters
   ii. Median filter
   iii. Midpoint filter. **(Dec 11)**

8. Explain the following:
   i. Spatial processing
   ii. Color vectoring processing. **(Dec 11)**

9. What is the role of image Enhancement in Image processing and describe image Enhancement methods in spatial domain? **(Dec 11)**

10. Write short notes on the following: Gray level transformations. **(Dec 11)**

11. Explain the following Order - Statistics Filters.
   i. Max and min filters
   ii. Median filter
   iii. Alpha-Trimmed mean filter **(May 10)**

12. What is spatial filtering? How it is useful for Image enhancement, also discuss different types spatial filters used in Image enhancement. **(May 10)**

13. Explain the concept of generation of spatial masks form frequency domain specifications. **(May 10)**

14. What is histogram of an Image. Sketch histograms of basic Image types. Discuss how histogram is useful for Image enhancement. **(May 10)**

15. Discuss the frequency domain techniques of Image enhancement in detail. **(May 10)**

16. i. Explain Constant area coding.
   ii. Explain Bit=Plane decomposition technique. **(May 10)**

17. i. Give the algorithm for histogram equalization.
   ii. What is the histogram distribution for high contrast, low contrast images. **(May10)**

18. i. Explain the need for Image enhancement.
   ii. Explain Gray level transformation functions for contrast enhancement. **(May 10)**

19. Suppose that you from a Low pass spatial filter that average the 4-neighbors of point (x,y), but excludes the point (x,y) itself

i. Find the equivalent filter H(u,v) in the frequency domain

ii. Show that your result a low pass filter. **(May 10)**

20. Discuss following histogram techniques for Image enhancement.

i. Histogram specification.

ii. Local enhancement. **(May 10)**

21. Answer the following from the given 3X 3 image Assume that the Prewitt masks are used to obtain Gx and Gy.

Show that the gradient

Computed by f =mag (f) $[G^2_x + G^2_y]^{1/2}$ and f =|Gx| + [Gy] give identical for edges oriented in the horizontal and vertical directions.

Note: masks usd to compute the gradient at point labeled Z_5.

f= mag (f) $[G^2_x + G^2_y]^{1/2}$ and $[G^2_x + G^2_y]^{1/2}$ f= |Gx| + |Gy| give identical results for edges oriented in the horizontal and vertical directions.

22. i. Explain about the following point processing techniques for image enhancement:

   i. Compression of dynamic range

   ii. Gray level slicing

ii. Compare histogram processing and histogram specification methods **(Nov 08)**

23. Sketch perspective plot of an 2-D ideal Low pass filter transfer function and filter cross section and explain its usefulness in image enhancement. **(Nov 08)**

24. Discuss few examples of how logical operations may be performed on images. **(Nov 08)**

25. What is meant by perspective transform action? Derive the necessary relationships for perspective transformation. **(Nov 08)**

26. What is meant by image enhancement by point processing? Discuss any three point processing techniques with suitable examples. **(Nov 08)**

27. i. What is meant by image enhancement? Discuss the need for enhancement.

ii. Discuss the spatial domain methods for image enhancement. **(Nov 08)**

28. i. Explain about Histogram specification with necessary derivations

ii. What is meant by local enhancement? Discuss its importance. **(Nov 08)**

UNIT-III

1. i. Differentiate between Ideal and butter worth frequency domain filters. **(Nov 13)**

ii. Explain the image sharpening using butter worth filters and draw its frequency response plots.

2. i. What is a smoothing filter? Explain how this can be achieved using a median filter.

ii. What do you mean by sharpening an image? Explain how image sharpening is achieved in the frequency domain using a high -pass filter. **(Dec 12)**

3. i. Describe the techniques used for color image smoothing?

ii. What is the need of graylevel slicing in color images. **(Dec 11)**

4. What are the techniques used for image smoothing? Explain any two techniques of Frequency domain **(Dec 11)**

5. Draw and Explain the schematic diagram how pixels of an RBG color image are formed from the corresponding pixels of the three components images. **(Dec 11)**

6. Explain in detail about the CMY and HIS color spaces. **(Dec 11)**

7. What is the role of image Enhancement in Image processing and describe image Enhancement methods in spatial domain? **(Dec 11)**

8. Give the expression for 2-D Butterworth High pass filter transfer function and sketch it. Explain its usefulness in Image enhancement. **(May 10)**

9. Explain about the functionality of sharpening filters in frequency domain. **(Nov 08)**

10. Distinguish between smoothing and sharpening filters in terms of :
    i. Functionality
    ii. Types
    iii. Applications
    iv. Mask coefficients. **(Nov 08)**

11. Distinguish between spatial domain filtering and frequency domain filtering in terms of
    i. Defination
    ii. Filters / Masks used
    iii. Applications
    iv. Type of filters. **(Nov 08)**

12. In what way ideal LP and Butterworth LP filters are different? Explain **(Nov 08)**

13. Discuss the frequency domain techniques of image enhancement in detail. **(Nov 08)**

14. Discuss image smoothing with the following
    i. Low pass spatial filtering
    ii. Median filtering. **(Nov 08)**

15. i. What iso meant by image subtraction? Discuss various areas of application of image subtraction.
    ii. What iso meant by image averaging? Discuss the principle involved in it. And discuss various areas of applications of it. **(Nov 08)**

16. i. Explain about ideal low pass filter (ILPF) in frequency domain
    ii. Discuss about Butterworth low pass filter with a suitable example. **(Nov 08)**

17. i. Explain about Butter worth high pass filter with necessary expressions.
    ii. Discuss about generation of spatial marks from frequency domain specifications. **(Nov 08)**

18. i. Show that a high pass-filtered image in the frequency domain can be obtained by using the method of subtracting a low pass filtered image from the original.
    ii. Discuss the procedure for conversion from RGB colour model to HSI color model. **(Nov 08)**

19. Explain in detail the different derivative operations used for image sharpening. **(Dec 09)**

UNIT-IV

1. i. Compare inverse filtering and least mean squares filtering. **(Nov 13)**
   ii. Discuss about least mean squares filtering and derive its transfer function.

2. i. Explain the steps involved in the constrained least squares restoration procedure of an image
   ii. What do you mean by interactive image restoration? **(Dec 12)**

3. Show that if a filter transfer function H(4,v) is real and symmetric, then the corresponding spatial domain filter h(x,y) also B real and symmetric. **(Dec 11)**

4. i. Explain clearly the wiener filter with reference to image restoration.
   ii. What is degradation model and Discuss about the inverse filter? **(Dec 11)**

5. Explain about Iterative Nonlinear Restoration Using the Lucy-Richardson Algorithm. **(May 10)**

6. i. Distinguish between image restoration and images enhancement. Explain about image degradation process.
   ii. Explain the procedure to obtain block circulant matrix. **(Nov 08)**

7. i. What is the need for diagonalization of circulant matrix? Explain diagonalization of circulant matrix.
   ii. Write short notes on inverse filtering. **(Nov 08)**

8. Explain about iterative Nonlinear Restoration Using the Lucy- Richardson Algorithm. **(Nov 08)**

9. Explain about detail the interactive restoration of an image. **(Nov 08)**

10. State and explain various algebraic approaches to image restoration. **(Nov 08)**

11. i. What is meant by image degradation? Discuss various possibilities for image degradation.
    ii. Explain about Gray-level interpolation. **(Nov 08)**

12. i. Explain the image degradation model for continuous functions
    ii. Discuss about unconstrained, constrained restorations. **(Nov 08)**

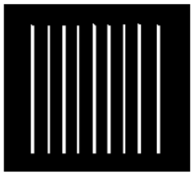
UNIT-V

1. i. What is difference between thresholding based and region based segmentation. **(Nov 13)**
   ii. Describe the region splitting and merging algorithm.

2. i. What do you mean by thresholding? Explain optimal thresholding technique.
   ii. Explain region growing by pixel aggregation for image segmentation. **(Dec 12)**

3. i. Write about various edge Detectors available in function edge.
   ii.. What is Thresholding? Explain about Local Thresholding. **(Dec 11)**

4. The white bars in the test pattern shown in figure 5b are 7 pixels wide and 210 pixels high. The separation between bars is17 pixels. What would this image look like after application of
   i. A 9 x 9 min filter? ii. A 5 x 5 min filter?



(Dec 11)

5. Answer the following from the given 3 x 3 region of image and various masks used to compute the gradient at point labledz5 Assume that the Sobel masks are used to obtain Gx and Gy. Show that the gradient computed by $\nabla f = \text{mag}(\nabla f)[G_x^2+G_y^2]^{1/2}$ and $\nabla f = |Gx| + |Gy|$ give identical results for edges oriented in the horizontal and vertical directions.

Z1	Z2	Z3
Z4	Z5	Z6
Z7	Z8	Z9

(Dec 11)

6. Explain the principle of Laplacian operator for edge detection. **(Dec 11)**

7. i. Write about zero crossing Detector.
   ii. Explain about Canny Edge Detector. **(May 10)**

8. Explain the following edge linking methods:
   i. Local processing
   ii. Hough transform method. **(Nov 08)**

9. What is the basic concept of image segmentation? What are the different algorithms used? Explain the method of segmentation using graph theoritic approach. **(Nov 08)**

10. Write about various edge Detectors available in function edge. **(Nov 08)**

11. i. Explain in detail the threshold selection based on boundary characteristics.
    ii. Discuss about Region growing by pixel aggregation. **(Nov 08)**

12. i. What is meant by Gradient operators? Discuss how edge detection can be done by it.
    ii. What iso meant by Laplacian of an image? Discuss its significance in edge detection. **(Nov 08)**

13. i. Discuss with suitable examples the method of Region Splitting and Merging.
    ii. Prove that the average value of any image convolved with laplacian operator (^{2}h) is zero. **(Nov 08)**

14. i. Explain briefly about combined detection.
    ii. Discuss the methods for detecting the discontinuities in an image. **(Dec 09)**

15. i. Explain briefly about combined detection.
    ii. Discuss the methods for detecting the discontinuities in an image. **(Dec 09)**

UNIT-VI

1. i. Define the coding, inter pixel and psychovisual redundancies.
   ii. Obtain the tag using arithmetic coding to transmit the word ‘INDIA’.

2. i. Explain the term objective fidelity criterion uses to assess the level of information loss.
ii. Construct a Huffman code for the data given below;

Gray scale	0	1	2	3	4	5	6	7
Probability	0.07	0.11	0.08	0.04	0.5	0.05	0.06	0.09

(Dec 12)

3. What is Error Free Compression? Explain about variable length coding. **(Dec 11)**

4. What is Noise? what are the spatial and frequency properties of noise? **(Dec 11)**

5. Draw a figure of a basic DPCM/DCT encoder for motion compensated video compression. **(Dec 11)**

6. An 8 level image has the gray level distribution given in table. **(Dec 11)**

r_k	$P_r(r_k)$	Code 1	$L_1(r_k)$	Code 2	$L_2(r_k)$
$r_0 = 0$	0.19	000	3	11	2
$r_1 = 1/7$	0.25	001	3	01	2
$r_2 = 1/7$	0.21	010	3	10	2
$r_3 = 3/7$	0.10	011	3	001	3
$r_4 = 4/7$	0.08	100	3	0001	4
$r_5 = 5/7$	0.06	101	3	00001	5
$r_6 = 6/7$	0.03	110	3	000001	6
$r_7 = 1$	0.02	111	3	000000	6

i. Compute the average word length for each code and compare the to entropy form part.
ii. Divide the symbols into two blocks of four and construct the best Huffman shift code. **(Dec 11)**

7. An 8 level image has the gray level distribution given in table.

r_k	$P_r(r_k)$	Code 1	$L_1(r_k)$	Code 2	$L_2(r_k)$
$r_0 = 0$	0.19	000	3	11	2
$r_1 = 1/7$	0.25	001	3	01	2
$r_2 = 1/7$	0.21	010	3	10	2
$r_3 = 3/7$	0.10	011	3	001	3
$r_4 = 4/7$	0.08	100	3	0001	4
$r_5 = 5/7$	0.06	101	3	00001	5
$r_6 = 6/7$	0.03	110	3	000001	6
$r_7 = 1$	0.02	111	3	000000	6

i. Construct the best 2-bitbinary shift code.
ii. Construct the best B1- code for the distribution. **(Dec 11, May 10)**

8. Explain in detail the lossy & loss less compression models with block diagrams. **(Dec 11)**

9. i. Explain about Huffman coding with an example.
ii. Give the arithmetic coding with an example. **(Dec 11)**

10. Write short notes on the following: JPEG 2000 Image compression standard. **(Dec 11)**

11. Explain in detail the lossy & loss less compression models with block diagrams. **(Dec 11)**

12. i. Can variable length coding procedures be used to compress a histogram equalized image with 2^n gray levels explain

ii. Can such an image contain interpixel redundancies that could be exploited for data compression?

(May 10)

13. Explain about the following:

i. Lossy compression

ii. Lossy predictive coding. **(May 10)**

14. Explain clearly with a block diagram about lossy predictive coding methods. **(Nov 08)**

15. What are the advantages and disadvantages of fixed length and variable length coding? Explain one method for each assuming necessary data. **(Nov 08)**

16. i. Draw and explain a general compression system model.

ii. Draw the relevant diagram for source encoder and source decoder. **(Nov 08)**

17. With a neat diagram explain the lossy predictive coding model. **(Nov 08)**

18. What is meant by error free compression? State and explain various techniques is it.

(Nov 08)

19. i. Discuss the functioning of source encoder and decoder in image compression.

ii. Explain about Huffman coding with suitable examples. **(Nov 08)**

20. i. Explain the applications of source coding in the field of image processing.

ii. With an example explain the loss-less predictive coding. **(Dec 09)**

21. i. Explain the applications of source coding in the field of image processing.

ii. With an example explain the loss-less predictive coding. **(Dec 09)**

UNIT-VII

1. i. Compare continuous and discrete wavelet transforms. **(Nov 13)**

ii. List out any five continuous wave-lets and their functions.

2. i. Explain the concept of denoisng using wavelets.

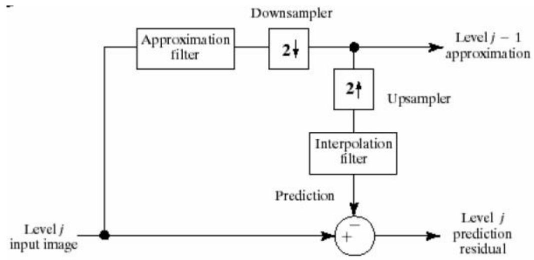
ii. What is Digital Image Watermarking? **(Dec 12)**

3. i. Discuss the concept FWT and draw the flow graph for N=8.

ii. Compare the FFT and FWT. **(Dec 11)**

4. Design a system for decoding the prediction residual pyramid generated by the encoder of (fig.7.2 (b)). an Image pyramid and draw its block diagram. Assume there is no quantization error introduced by the encoder.

(T1.Ch7)



5. Construct a fully populated approximation pyramid and corresponding prediction residual pyramid for the Image.

$$f(x)=\begin{bmatrix}1 & 2 & 3 & 4\\ 5 & 6 & 7 & 8\\ 9 & 10 & 11 & 12\\ 13 & 14 & 15 & 16\end{bmatrix}$$

Use 2x2 block neighborhood averaging for the approximation filter in fig.7.2(b) and assume the interpolation filter implements pixel, replication. **(T1.Ch7)**

6. Given a 2Jx2J image, does a J+1 level pyramid reduce or expand the amount of data required to represent the image? What is the compression or expansion ratio? **(T1.Ch7)**

7. Given the sequence f(n)={0, 0.5, 0.25, 1} where n=0,1,2,3 compute:
   i. The Sign reversed sequence
   ii. The order reversed sequence
   iii. The modulated sequence.
   iv. The modulated and then order reversed sequence.
   v. The order reversed and then modulated sequence.
   vi. Does the result form (d) or (e) correspond to equation. (7.1-9) **(T1.Ch7)**

8. Compute the coefficients of the Daubechies synthesis filters g0(n) and g1(n) for example 7.2, using equation (7.1-13) with m=0 only, show that the filters are orthonormal. **(T1.Ch7)**

9. Draw a two dimensional four band filter bank decoder to reconstruct input f(m, n) in fig.7.7 **(T1.Ch7)**

10. Obtain the Haar transformation matrix for N=8 **(T1.Ch7)**

11. Compute the Haar transform of the 2x2 Image.

$$F=\begin{bmatrix}3 & -1\\ 6 & 2\end{bmatrix}$$ **(T1.Ch7)**

12. Draw the FWT filter bank required to compute the transform in problem 7.16. Label all inputs and outputs with the appropriate sequences. **(T1.Ch7)**

13. The computational complexity of an M-point fast wavelet transform is O(M). That is the number of operation is proportional M. What determines the constant of proportionately. **(T1.Ch7)**

14. Explain about wavelet Transforms in one dimension?

15. Explain the Image compression models

UNIT-VIII

1. i. Explain OR, AND, NOT and XOR logical operations. **(Nov 13)**
   ii. The input picture and structuring element is shown below. Perform closing operation.

0 1 1 0
1 0 0 1
1 0 0 1
0 1 1 0
The input Picture

0 1 0
1 1 1
0 1 0
Structuring element

2. Write short notes on:
   i. Hit-or-Miss transform.
   ii. Dilation and erosion. **(Dec 12)**

3. i. What is homomorphic filtering? Why it is so called? Explain its principle.
   ii. Compare and contrast Ideal and Butterworth LPFs. **(Nov 08)**

4. Explain the concept of homomorphic filtering. **(Nov 08)**

5. Explain the features of dilation and Erosion. **(T1.Ch9)**

6. Explain the Region Based segmentation. **(T1.Ch9)**

7. What is Mathematical Morphology? **(T1.Ch9)**

8. What is the limiting effect of repeatedly dilating an image? Assume that a trival (one point) structuring element is not used. **(T1.Ch9)**

9. What is the smallest image from which you can start in order for your answer in part (a) to hold? **(T1.Ch9)**

10. What is the limiting effect of repeatedly eroding an image? Assume that a trival (one point) structuring element is not used. **(T1.Ch9)**

11. What is the smallest image from which you can start in order for your answer in part(a) to hold? **(T1.Ch9)**

12. Prove the validity of the duality expression in equation (9.2-6) **(T1.Ch9)**

13. Prove the validity of the duality expressions $(A*B)^c = (A^c.B)$ and $(A^c.B) = (A*B)^c$ **(T1.Ch9)**

14. Prove the validity of the expressions : A*B is a subset (subimage) of A. **(T1.Ch9)**

15. Prove the validity of the expressions A is a subset (subimage) of A. **(T1.Ch9)**

16. Give an expression based on reconstruction by dilation capable of extrading all the holes in a binary image. **(T1.Ch9)**

17. Explain what would happen in binary erosion and dilation if the structuring element is single point, valued 1. Give the reason(s) for your answer. **(T1.Ch9)**