IT6005 DIGITAL IMAGE PROCESSING

Question Bank [VII SEM ECE]

CONTENTS

Unit-I

Digital Image Fundamentals

Part-A

1. Define Image.
An image may be defined as two dimensional light intensity function f(x, y) where x and y denote spatial co-ordinate and the amplitude or value of f at any point (x, y) is called intensity or grayscale or brightness of the image at that point.

2. What is Dynamic Range? .
The range of values spanned by the gray scale is called dynamic range of an image. Image will have high contrast, if the dynamic range is high and image will have dull washed out gray look if the dynamic range is low.

3. Define Brightness. [May/June 2015] [Nov/Dec 2012]
Brightness of an object is the perceived luminance of the surround. Two objects with different surroundings would have identical luminance but different brightness.

4. Define Contrast [May/June 2015] [Nov/Dec 2012]
It is defined as the difference in intensity between the highest and lowest intensity levels in an image

5. What do you mean by Gray level? .
Gray level refers to a scalar measure of intensity that ranges from black to grays and finally to white.

6. What do you meant by Color model? .
A Color model is a specification of 3D-coordinates system and a subspace within that system where each color is represented by a single point.

7. List the hardware oriented color models[.May/Jun 2018] .
1. RGB model 2. CMY model 3. YIQ model 4. HSI model

8. What is Hue & saturation? [May/June 2014]
Hue is a color attribute that describes a pure color where saturation gives a measure of the degree to which a pure color is diluted by white light.

9. List the applications of color models. .
1. RGB model--- used for color monitor & color video camera
2. CMY model---used for color printing 3. HIS model----used for color image processing
4. YIQ model---used for color picture transmission

10. Define Resolution.
Resolution is defined as the smallest number of discernible detail in an image. Spatial resolution is the smallest discernible detail in an image and gray level resolution refers to the smallest discernible change is gray level.

11. What is meant by pixel? .
A digital image is composed of a finite number of elements each of which has a particular location or value. These elements are referred to as pixels or image elements or picture elements or pels elements.

12. Define Digital image? What is gray scale image? .
When x, y and the amplitude values of f all are finite discrete quantities, we call the image as digital image.

13. What are the steps involved in DIP? .
1. Image Acquisition 2. Preprocessing 3. Segmentation 4. Representation and Description
5. Recognition and Interpretation

14. What is recognition and Interpretation? .
Recognition means is a process that assigns a label to an object based on the information provided
by its descriptors. Interpretation means assigning meaning to a recognized object.

15. Specify the elements of DIP system.
1. Image Acquisition 2. Storage 3. Processing 4. Display

16. Explain the categories of digital storage? .
1. Short term storage for use during processing. 2. Online storage for relatively fast recall.
3. Archival storage for infrequent access.

17. What are the types of light receptors? .
The two types of light receptors are Cones and Rods

18. How cones and rods are distributed in retina? .
In each eye, cones are in the range 6-7 million and rods are in the range 75-150 million.

19. Define subjective brightness and brightness adaptation [May/June 2014]
Subjective brightness means intensity as preserved by the human visual system.
Brightness adaptation means the human visual system can operate only from scotopic to glare limit. It cannot operate over the range simultaneously. It accomplishes this large variation by changes in its overall intensity.

20. Differentiate photopic and scotopic vision

Photopic vision	Scotopic vision
1. The human being can resolve the fine details with these cones because each one is connected to its own nerve end. 2. This is also known as bright light vision.	Several rods are connected to one nerve end. So it gives the overall picture of the image. This is also known as thin light vision.

21. Define weber ratio.

The ratio of increment of illumination to background of illumination is called as weber ratio.(ie) $\Delta i/i$

If the ratio ($\Delta i/i$) is small, then small percentage of change in intensity is needed (ie) good brightness adaptation. If the ratio ($\Delta i/i$) is large, then large percentage of change in intensity is needed

(ie) poor brightness adaptation.

22. What is simultaneous contrast? [May/June 2015] [Nov/Dec 2012]

The region reserved brightness not depend on its intensity but also on its background. All centre square have same intensity. However they appear to the eye to become darker as the background becomes lighter.

23. What is meant by illumination and reflectance? .

Illumination is the amount of source light incident on the scene. It is represented as i(x, y). Reflectance is the amount of light reflected by the object in the scene. It is represented by r(x, y).

24. Define sampling and quantization.

Sampling means digitizing the co-ordinate value (x, y). Quantization means digitizing the amplitude value.

25. Find the number of bits required to store a 256 X 256 image with 32 gray levels.

32 gray levels = 2^5

No of bits for one gray level = 5; 256 * 256 * 5 = 327680 bits.

26. Write the expression to find the number of bits to store a digital image? .

The number of bits required to store a digital image is b=M X N X k where k is number bits required to represent one pixel When M=N, this equation becomes $b=N^2k$

27. What do you meant by Zooming and shrinking of digital images? .

Zooming may be viewed as over sampling. It involves the creation of new pixel locations and the assignment of gray levels to those new locations.

Shrinking may be viewed as under sampling. To shrink an image by one half, we delete every row and column. To reduce possible aliasing effect, it is a good idea to blue an image slightly before shrinking it.

28. Write short notes on neighbors of a pixel..

The pixel p at co-ordinates (x, y) has 4 neighbors (ie) 2 horizontal and 2 vertical neighbors whose co-ordinates is given by (x+1, y), (x-1,y), (x,y-1), (x, y+1). This is called as direct neighbors. It is denoted by $N_4(P)$ Four diagonal neighbors of p have co-ordinates (x+1, y+1), (x+1,y-1), (x-1, y-1), (x-1, y+1). It is denoted by $N_D(4)$. Eight neighbors of p denoted by $N_8(P)$ is a combination of 4 direct neighbors and 4 diagonal neighbors.

29. Define the term Luminance.

Luminance measured in lumens (lm), gives a measure of the amount of energy an observer perceiver from a light source.

30. What is monochrome image and gray image? [Nov/Dec 2012]

Monochrome image is an single color image with neutral background. Gray image is an image with black and white levels which has gray levels in between black and white. 8-bit gray image has 256 gray levels.

31. What is meant by path? .

Path from pixel p with co-ordinates (x, y) to pixel q with co-ordinates (s,t) is a sequence of

distinct pixels with co-ordinates.

32. Define checker board effect and false contouring. [Nov/Dec 2012]

Checker board effect is observed by leaving unchanged the number of grey levels and varying the spatial resolution while keeping the display area unchanged. The checkerboard effect is caused by pixel replication, that is, lower resolution images were duplicated in order to fill the display area.The insufficient number of intensity levels in smooth areas of digital image gives false contouring.

33.Define Mach band effect. [Nov/Dec 2013] [May/June 2013]

The spatial interaction of luminances from an object and its surround creates a phenomenon called the Mach band effect. This effect shows that brightness in not the monotonic function of luminance.

34.Define Optical illusion.

Optical illusions are characteristics of the human visual system which imply that" the eye fills in nonexisting information or wrongly perceives geometrical properties of objects."

35. Explain the types of connectivity. .

4 connectivity, 8 connectivity and M connectivity (mixed connectivity)

36. Compare RGB and HIS color image models[May/June 2013]

RGB model	HSI model
• RGB means red, green and blue color. • It represents colors of the image. • It is formed by either additive or subtractive model. • It is subjective process	• HSI represents hue, saturation and intensity of colors. • It decides the type of the color. • It numerically represents the average of the equivalent RGB value.

PART-B

1.What are the fundamental steps in Digital Image Processing? [May/June 2014] [Nov/Dec 2011] [May/June 2018]

2.Briefly discuss about the elements of Digital image Processing system [May/June 2015] [Nov/Dec 2011] [Nov/Dec 2017]

3.What is visual perception model and explain. How this is analogous to Digital Image Processing system[May/June 2014] [Nov/Dec 2016]

4.Explainin detail about image sensing and acquisition process[May/June 2018]

5.Explain the basic concepts of image sampling and quantization [May/June 2012] [Nov/Dec 2014] [Nov/Dec 2017]

6. Explain about color fundamentals. [May/June 2010]

7. Explain RGB color model [Nov/Dec 2011]

8. Explain CMY color model.

9. Explain HSI color Model.

10. Discuss the basic relationship between pixels [Nov/Dec 2011]

UNIT II
IMAGE ENHANCEMENT
PART-A

1. Specify the objective of image enhancement technique.

The objective of enhancement technique is to process an image so that the result is more suitable than the original image for a particular application.

2. Explain the 2 categories of image enhancement[May/June 2012]

i) Spatial domain refers to image plane itself & approaches in this category are based on direct manipulation of picture image.

ii) Frequency domain methods based on modifying the image by fourier transform.

3. What is contrast stretching? [May/June 2013]

Contrast stretching reduces an image of higher contrast than the original by darkening the levels below m and brightening the levels above m in the image.

4. What is grey level slicing?.

Highlighting a specific range of grey levels in an image often is desired. Applications include enhancing features such as masses of water in satellite imagery and enhancing flaws in x-ray images.

5. Define image subtraction.

The difference between 2 images f(x,y) and h(x,y) expressed as g(x,y)=f(x,y)-h(x,y) is obtained by computing the difference between all pairs of corresponding pixels from f and h.

6. What is the purpose of image averaging?.

An important application of image averaging is in the field of astronomy, where imaging with very low light levels is routine, causing sensor noise frequently to render single images virtually useless for analysis.

7. Give the formula for negative and log transformation..

Negative: S=L-1-r Log: S = c log(1+r) Where c-constant

8. What is meant by bit plane slicing?.

Instead of highlighting gray level ranges, highlighting the contribution made to total image

appearance by specific bits might be desired. Suppose that each pixel in an image is represented by 8 bits. Imagine that the image is composed of eight 1-bit planes, ranging from bit plane 0 for LSB to bit plane-7 for MSB

9. What is meant by masking?.

Mask is the small 2-D array in which the values of mask co-efficient determines the nature of process. The enhancement technique based on this type of approach is referred to as mask processing.

10. Define histogram.

The histogram of a digital image with gray levels in the range [0, L-1] is a discrete function $h(r_k)=n_k$.

r_k-k^{th} gray level; n_k-number of pixels in the image having gray level r_k.

11. What is meant by histogram equalization? [May/June 2012] [Nov/Dec 2015]

$S_k = T(r_k) = \sum_{j=0}^{k} P_r(r_j) = \sum_{j=0}^{k} n_j / n$; where k=0, 1,2,…, L-1

This transformation is called histogram equalization.

12. What do you mean by Point processing?.

Image enhancement at any Point in an image depends only on the gray level at that point is often referred to as Point processing.

13. What is Image Negatives? [Nov/Dec 2017]

The negative of an image with gray levels in the range [0, L-1] is obtained by using the negative transformation, which is given by the expression. s = L-1-r Where s is output pixel r is input pixel.

14. Define Derivative filter

For a function f (x, y), the gradient ∆f at co-ordinate (x, y) is defined as the vector

$\Delta f = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}$; mag (∆f) = $\{[(\partial f/\partial x)^2 + (\partial f/\partial y)^2]\}^{1/2}$

15. What is a Median filter?.

The median filter replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel.

16. Explain spatial filtering

Spatial filtering is the process of moving the filter mask from point to point in an image. For linear spatial filter, the response is given by a sum of products of the filter coefficients, and the corresponding image pixels in the area spanned by the filter mask

17. Give the mask used for high boost filtering.

0	-1	0
-1	A+4	-1
0	-1	0

-1	-1	-1
-1	A+8	-1
-1	-1	-1

18. What is maximum filter and minimum filter?.

The 100^{th} percentile is maximum filter is used in finding brightest points in an image. The 0^{th} percentile filter is minimum filter used for finding darkest points in an image.

19. Write the application of sharpening filters

1. Electronic printing and medical imaging to industrial application
2. Autonomous target detection in smart weapons.

20. Name the different types of derivative filters

1. Perwitt operators 2. Roberts cross gradient operators 3. Sobel operators

21. Define spatial averaging. [May/June 2014]

Spatial averaing is the process of finding out average of a center pixel and its neighbours. For linear spatial averaging, the response is given by a sum of products of the average filter mask, and the corresponding image pixels in the area spanned by the filter mask.

22.What is the need for transform?.

1. Certain mathematical operations can easily be implemented in frequency domain.
2. Transforms are very useful in gaining valuable insight into concepts such as sampling
3. Image transforms help to design faster algorithms
4. Transforms result in energy compaction over few co-efficient

23.What is Image Transform?.

An image can be expanded in terms of a discrete set of basis arrays called basis images. These basis images can be generated by unitary matrices. Alternatively, a given NxN image can be viewed as an N^2x1 vectors. An image transform provides a set of coordinates or basis vectors for vector space.

24. What are the applications of transform?.

1) To reduce band width 2) To reduce redundancy 3) To extract feature.

25. Give the Conditions for perfect transform..

1. Transpose of matrix = Inverse of a matrix. 2. Orthoganality.

26. What are the properties of unitary transform? [Nov/Dec 2013]

1) Determinant and the Eigen values of a unitary matrix have unity magnitude
2) The entropy of a random vector is preserved under a unitary Transformation
3) Since the entropy is a measure of average information, this means information is preserved under a unitary transformation.

27. Write the steps involved in frequency domain filtering..

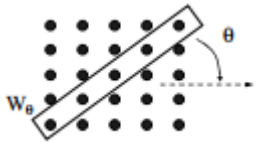
1. Multiply the input image by (-1) to center the transform.
2. Compute F(u,v), the DFT of the image from (1).
3. Multiply F(u,v) by a filter function H(u,v).
4. Compute the inverse DFT of the result in (3).
5. Obtain the real part of the result in (4). x+y
6. Multiply the result in (5) by (-1)

28. Give the formula for transform function of a Butterworth low pass filter..
The transfer function of a Butterworth low pass filter of order n and with cut off frequency at distance D_0 from the origin is, Where D(u,v) = [(u – M/2) + (v-N/2)]

29. Give the properties of the first and second derivative around an edge

- First-order derivative is nonzero at the onset and along the entire intensity ramp, producing thick edges
- The sign of the second derivative can be used to determine whether an edge pixel lies on the dark or light side of an edge.
- It produces two values for every edge in an image.
- An imaginary straight line joining the extreme positive and negative values of the second derivative would cross zero near the midpoint of the edge.

30. Define directional smoothing filter[Nov/Dec 2015]



*Compute spatial average along several directions.
*Take the result from the direction giving the smallest changes before
and after filtering.

31. Distinguish between image enhancement and image restoration[Nov/Dec 2015] [May/June 2017]
Enhancement technique is based primarily on the pleasing aspects it might present to the viewer. For example: Contrast Stretching. Whereas Removal of image blur by applying a deblurrings function is considered a restoration technique.

32.Name the different types of derivative filters in DIP[May/June 2018]
1.First order derivative 2. Second order derivative

PART-B

1. What is meant by image enhancement by point processing? Discuss any two methods in it.

2. What is the objective of image enhancement? Define spatial domain. Define point processing.

3. Define histogram of a digital image. Explain how histogram is useful in image enhancement? [May/June 2016]

4. Write about histogram equalization and specification. [May/June 2014] [Nov/Dec 2013]

5. Explain Sharpening of spatial filters.

6. Discuss about the mechanics of filtering in spatial domain. Mention the points to be considered in implementation neighbourhood operations for spatial filtering.

7. Write about Smoothing Spatial filters. [Nov/Dec 2014]

8. Write short notes on ideal Butterworth and Gaussian Filters

9. Describe histogram equalization. Obtain histogram equalization for the following image segment of size 5 X 5. Write the interference on the image segment before and after equalization.

20 20 20 18 16
15 15 16 18 15
15 15 19 15 17
16 17 19 18 16
20 18 17 20 15 (5 X 5) matrix [May/June'13]

10.Describe histogram equalization. Obtain histogram equalization for the following 8 bit image segment of size 5 X 5. Write the interference on the image segment before and after equalization.

200 200 200 180 240
180 180 180 180 190
190 190 190 190 180
190 200 220 220 240
230 180 190 210 230 (5 X 5) matrix [May/June'15]

11.i)Describe how homomorphic filtering is used to separate illumination and reflectance component.

ii) How color image is enhanced and compare it with grayscale processing?[May/June'15]

12.i) Explain histogram specification technique in detail with equations. [Nov/Dec'15]

ii) Discuss the following spatial enhancement techniques 1) Spatial averaging 2)median filtering.

13.Enumarate Discrete Fourier Transform in detail [May/June 2018]

UNIT III

IMAGE RESTORATION AND SEGMENTATION

PART-A

1. Give the relation/PDF for Gaussian noise and Rayleigh noise[May/June 2013]

Gaussian noise: The PDF Gaussian random variable Z is given by

$$P(Z)=e^{-(Z-\mu)^2/2\sigma^2}/\sqrt{2\pi}\sigma,$$

Where Z--Gray level value;σ-standard deviation;σ^2-variance of Z;

μ-mean of the gray level value Z.

Rayleigh noise: The PDF is

$$P(Z)=\begin{cases} 2(z-a)e^{-(z-a)2/b}/b & \text{for } Z>=a \\ 0 & \text{for } Z<a \end{cases}$$

Here ,Mean μ=a+√πb/4; Standard deviation σ^2=b(4-π)/4

2. Give the relation for Gamma noise, Exponential noise.

Gamma noise: The PDF is

$$P(Z)=\begin{cases} a^b z^{b-1} ae^{-az}/(b-1) & \text{for } Z>=0 \\ 0 & \text{for } Z<0 \end{cases}$$

Here,Mean μ=b/a; Standard deviation $\sigma^2=b/a^2$

Exponential noise : The PDF is

$$P(Z)=\begin{cases} ae^{-az} & Z>=0 \\ 0 & Z<0 \end{cases}$$

Here, Mean μ=1/a; Standard deviation $\sigma^2=1/a^2$

3. Give the relation for Uniform noise and Impulse noise[May/June 2013]

Uniform noise:The PDF is

$$P(Z)=\begin{cases} 1/(b-a) & \text{if } a<=Z<=b \\ 0 & \text{otherwise} \end{cases}$$

Mean μ=a+b/2 ; Standard deviation $\sigma^2=(b-a)^2/12$

Impulse noise:The PDF is

$$P(Z) = \begin{cases} P_a & \text{for } z=a \\ P_b & \text{for } z=b \\ 0 & \text{Otherwise} \end{cases}$$

4. What are possible ways for adding noise in images? [Nov/Dec 2013]

Image sensors, scanners, image acquisition, modify the pixel values, changing the background or foreground of an image, addition of two images, arithmetic operations between two images and image processing algorithms are the possible ways for adding noise in images.

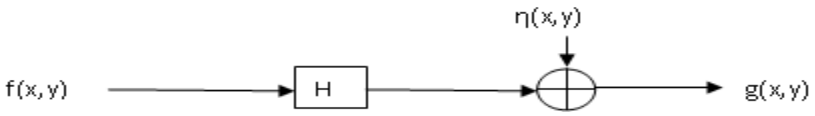
5. What is meant by Image Restoration?

Restoration attempts to reconstruct or recover an image that has been degraded by using a clear knowledge of the degrading phenomenon.

6. What is Local threshold and dynamic or adaptive threshold, global thresholding? [May/June 2013]

If Threshold T depends both on f(x,y) and p(x,y) is called local. If Threshold T depends on the spatial coordinates x and y the threshold is called dynamic or adaptive where f(x,y) is the original image.

7. How a degradation process is modeled? Or Define degradation model and sketch it. [May/June 2015] [Nov/Dec 2012]



A system operator H, which together with an additive white noise term η(x,y) operates on an input image f(x,y) to produce a degraded image g(x,y).

8. Define Gray-level interpolation

Gray-level interpolation deals with the assignment of gray levels to pixels in the spatially transformed image

9. What is meant by Noise probability density function?

The spatial noise descriptor is the statistical behavior of gray level values in the noise component of the model.

10. What is geometric transformation? [May/June 2012] [Nov/Dec 2015]

Transformation is used to alter the co-ordinate description of image.

The basic geometric transformations are 1. Image translation 2. Scaling 3. Image rotation

11. What is image translation and scaling?

Image translation means reposition the image from one co-ordinate location to another along straight line path. Scaling is used to alter the size of the object or image (ie) a co-ordinate system is scaled by a factor.

12. Which is the most frequent method to overcome the difficulty to formulate the spatial relocation of pixels?

The point is the most frequent method, which are subsets of pixels whose location in the input (distorted) and output (corrected) imaged is known precisely.

13. What are the three methods of estimating the degradation function?

1. Observation 2. Experimentation 3. Mathematical modeling.

The simplest approach to restoration is direct inverse filtering, an estimate F^(u,v) of the transform of the original image simply by dividing the transform of the degraded image G^(u,v) by the degradation function. $\widehat{F}(u,v) = \widehat{G}(u,v)/\mathrm{H}(u,v)$

14. What is pseudo inverse filter? [CO3-L1-Nov/Dec 2013]

It is the stabilized version of the inverse filter. For a linear shift invariant system with frequency response H(u,v) the pseudo inverse filter is defined as

$H^{-}(u,v)=1/(H(u,v)$ H#0

0 H=0

15. What is meant by least mean square filter or wiener filter? [CO3-L1-Nov/Dec 2012]

The limitation of inverse and pseudo inverse filter is very sensitive noise. The wiener filtering is a method of restoring images in the presence of blur as well as noise.

16. What is meant by blind image restoration? What are the two approaches for blind image restoration? .

An information about the degradation must be extracted from the observed image either explicitly or implicitly. This task is called as blind image restoration. The two approaches for blind image restoration are 1.Direct measurement 2. Indirect estimation

17. Give the difference between Enhancement and Restoration.

Enhancement technique is based primarily on the pleasing aspects it might present to the viewer. For example: Contrast Stretching. Whereas Removal of image blur by applying a deblurrings function is considered a restoration technique.

18. What do you mean by Point processing? .

Image enhancement at any Point in an image depends only on the gray level at that point is often referred to as Point processing.

19. What is Image Negatives? Give the formula for negative and log transformation.

The negative of an image with gray levels in the range [0, L-1] is obtained by using the negative transformation, which is given by the expression.

S=L-1-r; Log Transformation: S = c log(1+r) Where c-constant and ≥0

20.What is meant by bit plane slicing? [Nov/Dec 2013]

Instead of highlighting gray level ranges, highlighting the contribution made to total image appearance by specific bits might be desired. Suppose that each pixel in an image is represented by 8 bits. Imagine that the image is composed of eight 1-bit planes, ranging from bit plane 0 for LSB to bit plane-7 for MSB.

21. Why blur is to be removed from images? [Nov/Dec 2014]

The blur is caused by lens that is improper manner, relative motion between camera and scene and atmospheric turbulence. It will introduce bandwidth reduction and make the image analysis as complex. To prevent the issues, blur is removed from the images.

22. What is Lagrange multiplier? Where it is used? [Nov/Dec 2014]

The Lagrange multiplier is a strategy for finding the local minima and maxima of a function subject to equality constraints. This is mainly used in the image restoration process like image acquisition, image storage and transmission.

23. Compare constrained and unconstrained restoration[May/June 2014]

Constrained Restoration	Unconstrained Restoration
In the absence of any knowledge about the noise 'n', based on Lagrange multiplier and linear operator, a meaningful criterion function is to seek an $\hat{f}$ such that H$\hat{f}$ approximates of in a least square sense by assuming the noise term is as small as possible. Where H = system operator. $\hat{f}$ = estimated input image. g = degraded image.	In the absence of any knowledge about the noise 'n', a meaningful criterion function is to seek an $\hat{f}$ such that H$\hat{f}$ approximates of in a least square sense by assuming the noise term is as small as possible. Where H = system operator. $\hat{f}$ = estimated input image. g = degraded image.

24.What is the principle of inverse filtering? [May/June 2014]

Inverse filtering is given by

$$\hat{F}(u,v) = \frac{G(u,v)}{H(u,v)}$$

$\hat{F}(u,v)$-restored image. G(u,v) – Degraded image H(u,v)-Filter transfer function

25. Define rubber sheet transformation[May/June 2013]

Geometric transformations may be viewed as the process of printing an image on a rubber sheet and then stretching the sheet according to some predefined set of rules .Therefore they are also called as rubber sheet transformations.

26. What is segmentation? Write the applications of segmentation. **[Nov/Dec 2013]**

Segmentation is the process of portioning an image into its constitute regions or objects based on certain criteria. Image segmentation algorithms are based on either discontinuity principle or similarity principle.

* Detection of isolated points. * Detection of lines and edges in an image.

27. What is edge? What are the two properties used for establishing similarity of edge pixels? [Nov/Dec 2013]

An edge is a set of connected pixels that lie on the boundary between two regions edges are more closely modeled as having a ramp like profile. The slope of the ramp is inversely proportional to the degree of blurring in the edge.

Properties used for establishing similarity of edge pixels :(1) The strength of the response of the gradient operator used to produce the edge pixel. (2) The direction of the gradient

28. Define region growing .Give the principle of region growing[Nov/Dec 2015]

Region growing is a procedure that groups pixels or subregions in to layer regions based on predefined criteria. The basic approach is to start with a set of seed points and from there grow regions by appending to each seed these neighboring pixels that have properties similar to the seed.

29. State the problems in region splitting and merging based image segmentation. [Nov/Dec 2014]

- Initial seed points – different set of initial seed point cause different segmented result.
- Time consuming problem
- This method is not suitable for color images and produce fault colors sometime.
- Region growth may stop at any time when no more pixels satisfy the criteria.

30. What are factors affecting the accuracy of region growing? [May/June 2014]

The factors affecting the accuracy of region growing are like lightning variations, pixel's intensity value.

31. Write sobel horizontal and vertical edge detection masks. [May/June 2014]

Horizontal masking Vertical masking

-1	-2	-1
0	0	0
1	2	2

-1	0	1
-2	0	2
-1	0	1

32. Define region splitting and merging. Specify the steps involved in splitting and merging [May/June 2014] [May/June 2014]

Region splitting and merging is a segmentation process in which an image is initially subdivided into a set of arbitrary ,disjoint regions and then the regions are merger and /or splitted to satisfy the basic conditions.

Split into 4 disjoint quadrants any region Ri for which P(Ri)=FALSE. Merge any adjacent regions Rj and Rk for which P(RjURk)=TRUE. Stop when no further merging or splitting is positive.

PART-B

1.Write about various Noise Probability Density Functions. [May/June 2010]

2.Explain various Mean filters.

3. Explain the Order-Statistic Filters.

4. Explain the Adaptive Filters. [May/June 2018]

5. Write brief notes on inverse filtering. [May/June 2010] . [May/June 2018] [Nov/Dec 2017]

6. Explain the various noise reduction filters. .

7.What is Wiener filter? Mention its importance. [May/June 2011] [Nov/Dec 2012] . [May/June 2018]

8.Explain in detail about the process of edge linking and boundary detection? (May/June-2013)

9. **Explain the principle of Region splitting and merging in details. [May/June 2013] [Nov/Dec 2010]**

10. **Explain Erosion and Dilation in morphological processing.**

11. What is the objective of image segmentation? Explain any one of region based segmentation in detail. [Nov/Dec 2017]

UNIT IV

WAVELETS AND IMAGE COMPRESSION

PART-A

1. What is image compression? .

Image compression refers to the process of redundancy amount of data required to represent the given quantity of information for digital image. The basis of reduction process is removal of redundant data.

2. What is Data Compression? .

Data compression requires the identification and extraction of source redundancy. In other words, data compression seeks to reduce the number of bits used to store or transmit information.

3.What are two main types of Data compression? [May/June 2018].

Lossless compression can recover the exact original data after compression. It is used mainly for compressing database records, spreadsheets or word processing files, where exact replication of the original is essential.

1. Lossy compression will result in a certain loss of accuracy in exchange for a substantial increase in compression. Lossy compression is more effective when used to compress graphic images and digitized voice where losses outside visual or aural perception can be tolerated

4. What are different Compression Methods? [May/June 2018] .

Run Length Encoding (RLE) Arithmetic coding Huffman coding and Transform coding

5. Define coding redundancy[Nov/Dec 2015]

If the gray level of an image is coded in a way that uses more code words than necessary to represent each gray level, then the resulting image is said to contain coding redundancy.

6. Define interpixel redundancy.

The value of any given pixel can be predicted from the values of its neighbors. The information carried by is small. Therefore the visual contribution of a single pixel to an image is redundant. Otherwise called as spatial redundant geometric redundant or interpixel redundant. Eg: Run length coding

7. What is run length coding? [May/June 2015] [Nov/Dec 2012]

Run-length Encoding or RLE is a technique used to reduce the size of a repeating string of characters. This repeating string is called a *run*; typically RLE encodes a run of

symbols into two bytes, a count and a symbol. RLE can compress any type of data regardless of its information content, but the content of data to be compressed affects the compression ratio. Compression is normally measured with the compression ratio.

8. Define compression ratio. [May/June 2012]
Compression Ratio = original size / compressed size

9. Define psycho visual redundancy. .
In normal visual processing certain information has less importance than other information. So this information is said to be psycho visual redundant.

10. Compare lossy and lossless compression technique [May/June 2014]

In terms of storage, the capacity of a storage device can be effectively increased with methods that compress a body of data on its way to a storage device and decompress it when it is retrieved.

1. In terms of communications, the bandwidth of a digital communication link can be effectively increased by compressing data at the sending end and decompressing data at the receiving end.
2. At any given time, the ability of the Internet to transfer data is fixed. Thus, if data can effectively be compressed wherever possible, significant improvements of data throughput can be achieved. Many files can be combined into one compressed document making sending easier.

Lossless compression technique	Lossy compression technique
*In lossless data compression, the integrity of the data is preserved. The original data and the data after compression and decompression are exactly the same because, in these methods, the compression and decompression algorithms are exact inverses of each other: no part of the data is lost in the process. *Redundant data is removed in compression and added during decompression. *Lossless compression methods are normally used when we cannot afford to lose any data.	*Our eyes and ears cannot distinguish subtle changes. In such cases, we can use a lossy data compression method. *These methods are cheaper—they take less time and space when it comes to sending millions of bits per second for images and video. *Several lossy compression techniques are JPEG (Joint Photographic Experts Group) encoding is used to compress pictures and graphics, MPEG (Moving Picture Experts Group) encoding is used to compress video, and MP3 (MPEG

*Some techniques are run-length encoding, Huffman coding, Lempel Ziv encoding	audio layer 3) for audio compression

11. Define encoder.
Source encoder is responsible for removing the coding and interpixel redundancy and psycho visual redundancy. There are two components A) Source Encoder B) Channel Encoder

12. Define channel encoder. .

The channel encoder reduces the impact of the channel noise by inserting redundant bits into the source encoded data. Eg: Hamming code

13. What are the operations performed by error free compression? [May/June 2017].
1) Devising an alternative representation of the image in which its interpixel redundant are reduced.
2) Coding the representation to eliminate coding redundancy

14. What is Variable Length Coding? .
Variable Length Coding is the simplest approach to error free compression. It reduces only the coding redundancy. It assigns the shortest possible codeword to the most probable gray levels.

15. Define Huffman coding and mention its limitation [May/June 2012] [Nov/Dec 2013]
1. Huffman coding is a popular technique for removing coding redundancy.
2. When coding the symbols of an information source the Huffman code yields the smallest possible number of code words, code symbols per source symbol.

Limitation: For equiprobable symbols, Huffman coding produces variable code words.

16. Define Block code.
Each source symbol is mapped into fixed sequence of code symbols or code words. So it is called as block code.

17. Define B2 code.
Each code word is made up of continuation bit c and information bit which are binary numbers. This is called B2 code or B code. This is called B2 code because two information bits are used for continuation bits

18. Define the procedure for Huffman shift coding [May/June 2013] [Nov/Dec 2012]

List all the source symbols along with its probabilities in descending order. Divide the total number of symbols into block of equal size. Sum the probabilities of all the source symbols outside the reference block. Now apply the procedure for reference block, including the prefix source symbol. The code words for the remaining symbols can be constructed by means of one or more prefix code followed by the reference block as in the case of binary shift code.

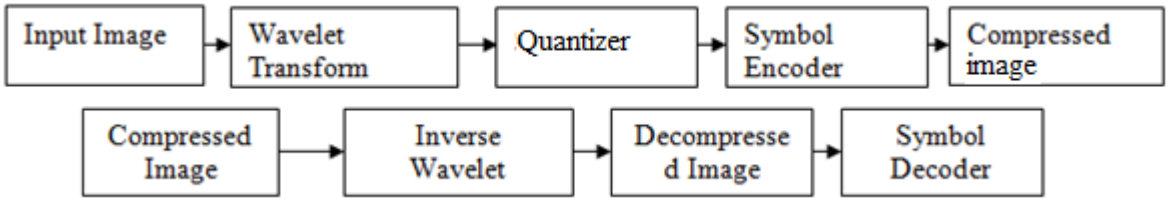
19. Define arithmetic coding.

In arithmetic coding one to one corresponds between source symbols and code word doesn't exist where as the single arithmetic code word assigned for a sequence of source symbols. A code word defines an interval of number between 0 and 1.

20. What is bit plane Decomposition? .

An effective technique for reducing an image's interpixel redundancies is to process the image's bit plane individually. This technique is based on the concept of decomposing multilevel images into a series of binary images and compressing each binary image via one of several well-known binary compression methods.

21. Draw the block diagram of transform coding system. .



22. How effectiveness of quantization can be improved? .

1. Introducing an enlarged quantization interval around zero, called a dead zero.
2. Adapting the size of the quantization intervals from scale to scale. In either case, the selected quantization intervals must be transmitted to the decoder with the encoded image bit stream.

23. What are the coding systems in JPEG? [Nov/Dec 2013]

1. A lossy baseline coding system, which is based on the DCT and is adequate for most compression application. 2.An extended coding system for greater compression, higher precision or progressive reconstruction applications. 3. A lossless independent coding system for reversible compression.

24. What is JPEG? .

The acronym is expanded as "Joint Photographic Expert Group". It is an international standard in 1992. It perfectly Works with color and grayscale images, Many

applications e.g., satellite, medical.

25. What is MPEG? .

The acronym is expanded as "Moving Picture Expert Group". It is an international standard in 1992. It perfectly Works with video and also used in teleconferencing

26. Define I-frame.

I-frame is Intraframe or Independent frame. An I-frame is compressed independently of all frames. It resembles a JPEG encoded image. It is the reference point for the motion estimation needed to generate subsequent P and P-frame.

27. Define P-frame.

P-frame is called predictive frame. A P-frame is the compressed difference between the current frame and a prediction of it based on the previous I or P-frame

28. Define B-frame.

B-frame is the bidirectional frame. A B-frame is the compressed difference between the current frame and a prediction of it based on the previous I or P-frame or next P-frame. Accordingly the decoder must have access to both past and future reference frames.

29. What is shift code? [Nov/Dec 2014]

The two variable length codes (Binary shift, Huffman Shift) are referred to as shift codes.

A shift code is generated by

i) Arranging probabilities of the source symbols are monotonically decreasing.

ii) Dividing the total number of symbols into symbol blocks of equal size.

iii) Coding the individual elements within all blocks identically.

iv) Adding special shift up/down symbols to identify each block.

30. List the advantages of transform coding. [May/June 2013]

Very efficient multiplier less implementation, to provide high quality digitization . Transform Coding may also be used for the efficient encoding of sequences which are not successive samples of a waveform, but samples of N correlated sources.

PART-B

1.Explain in detail about subband coding.

2. Explain in detail about Multiresolution Expansions.

3.Explain with neat block diagram of JPEG Encoder and decoder [May/June 2015] [Nov/Dec 2012] [Nov/Dec 2017]

4.Explain MPEG standard (Video compression standard) for monochrome and color compression? [Nov/Dec 2014]

5. Explain the arithmetic coding process in variable length coding with an example[May/June 2014] [Nov/Dec 2014]

6. Explain variable length coding with Huffman coding with one example] (or) Design a Huffman code for the source of a set character, A = { a1, a2, a3, a4, a5 } with the probabilities P = {0.2, 0.4, 0.2, 0.1, 0.1} Find Huffman code and calculate the average length of the code and redundancy[May/June 2013]

7. A source emits three symbols A, B, C with probabilities {0.5, 0.25, 0.25}respectively.construct an arithmetic code to encode the word 'C A B' [Nov/Dec 2015]

8. Construct Huffman code for the word "BABY".Also compute the efficiency of huffman code [May/June 2017]

9. **Explai how compression is achived in transform coding and explain about DCT [May/June 2018].**

10. Explain in detail about Lossless predictive coding.

11.Explain wavelet coding system.

12. Explain about lossy predictive coding.

UNIT V

IMAGE REPRESENTATION AND RECOGNITION

PART-A

1. Specify the various image representation approaches.

Chain codes, Polygonal approximation, Boundary segments

2. Define chain code. [May/June 2017]

Chain codes are used to represent a boundary by a connected sequence of straight line segment of specified length and direction. Typically this representation is based on 4 or 8 connectivity of segments. The direction of each segment is coded by using a numbering scheme.

3. What are the demerits of chain code?

The demerits of chain code are, i.The resulting chain code tends to be quite long. ii.Any small disturbance along the boundary due to noise cause changes in the code that may not be related to the shape of the boundary.

4. What is polygonal approximation method?]

Polygonal approximation is a image representation approach in which a digital boundary can be approximated with arbitrary accuracy by a polygon. For a closed curve the approximation is exact when the number of segments in polygon is equal to the number of points in the boundary so that each pair of adjacent points defines a segment in the polygon.

5. Specify the various polygonal approximation methods.

The various polygonal approximation methods are i.Minimum perimeter polygons. ii.Merging techniques. iii.Splitting techniques.

6. Name few boundary descriptors.

i.Simple descriptors. ii.Shape descriptors. iii.Fourier descriptors.

7. Define length of a boundary.

The length of a boundary is the number of pixels along a boundary. Example, for a chain coded curve with unit spacing in both directions, the number of vertical and horizontal components plus $\sqrt{2}$ times the number of diagonal components gives its exact length.

8. Give the formula for diameter of boundary

The diameter of a boundary B is defined as Diam(B)=max[D(pi,pj)] i,j

D-distance measure pi,pj-points on the boundary

9. Define eccentricity and curvature of boundary
Eccentricity of boundary is the ratio of the major axis to minor axis. Curvature is the rate of change of slope.

10. Define shape numbers.
Shape number is defined as the first difference of smallest magnitude. The order n of a shape number is the number of digits in its representation.

11. Give the Fourier descriptors for the following transformations
(1)Identity (2) Rotation (3) Translation (4) Scaling (5) Starting point

12. Specify the types of regional descriptors
Simple descriptors, Texture

13.Name few measures used as simple descriptors in region descriptors.
i.Area ii.Perimeter. iii.Mean and median gray levels iv.Minimum and maximum of gray levels. v.Number of pixels with values above and below mean.

14. Define texture. [Nov/Dec 2016]
Texture is one of the regional descriptors. It provides measure measures of properties such as smoothness, coarseness and regularity.

15. Define compactness.
Compactness of a region is defined as (perimeter)2 / area. It is a dimensionless quantity and is insensitive to uniform scale changes.

16. List the approaches to describe texture of a region.
The approaches to describe the texture of a region are, i.Statistical approach. ii.Structural approach. iii.Spectural approach.

17.What is thinning or skeletonizing algorithm? [Nov/Dec 2016]
An important approach to represent the structural shape of a plane region is to reduce it to a graph. This reduction may be accomplished by obtaining the skeletonizing algorithm. It plays a central role in a broad range of problems in image processing, ranging from automated inspection of printed circuit boards to counting of asbestos fibers in air filter.

18. What is pattern and pattern class? [Nov/Dec 2017] [May/June 2017]
Pattern is a quantitative or structural description of an object or some other entity of interest in an image. It is formed by one or more descriptors.
Pattern class is a family of patterns that share some common properties. Pattern classes are denoted as w1 w2 w3 …… wM , where M is the number of classes.

19. What is pattern recognition?
It involves the techniques for arranging pattern to their respective classes by automatically and with a little human intervention.

20. What are the three principle pattern arrangements?

The three principal pattern arrangements are vectors, Strings and trees. Pattern vectors are represented by old lowercase letters such as x ,y, z and it is represented in the form x=[x1, x2, …….., xn]. Each component x represents I th descriptor and n is the number of such descriptor.

21.What is meant by markers?

An approach used to control over segmentation is based on markers. marker is a connected component belonging to an image. We have internal markers, associated with objects of interest and external markers associated with background.

22. What are the 2 principles steps involved in marker selection?

The two steps are 1. Preprocessing2. Definition of a set of criteria that markers must satisfy.

23.Describe statistical approach

Statistical approaches describe smooth,coarse,grainy characteristics of texture.This is the simplest one compared to others. It describes texture using statistical moments of the gray-level histogram of an image or region.

24. Define gray-level co-occurrence matrix.

A matrix C is formed by dividing every element of A by n(A is a k x k matrix and n is the total number of point pairs in the image satisfying P(position operator). The matrix C is called gray-level cooccurrence matrix if C depends on P, the presence of given texture patterns may be detected by choosing an appropriate position operator.

25. Explain structural and spectral approach.

Structural approach deals with the arrangement of image primitives such as description of texturebased on regularly spaced parallel lines.Spectral approach is based on properties of the Fourier spectrum and primarily to detect global periodicity in an image by identifying high energy, narrow peaks in spectrum. There are 3 features of Fourier spectrum that are useful for texture description. They are i) Prominent peaks in spectrum gives the principal direction of texture patterns. ii) The location of peaks in frequency plane gives fundamental spatial period of patterns.iii) Eliminating any periodic components by our filtering leaves non- periodic image elements

PART-B

1.Explain the boundary representation of object and chain codes[May/June 2018].

2. **Explain Polygonal approximations.**

3. Write short notes on Signatures.

4. Explain Boundary Segments.

5. Explain in detail the various Boundary descriptors with a neat diagram[May/June 2017]. .

6. Explain in detail the various FOURIER descriptors with a necessary equations. [Nov/Dec 2017]

7. Explain in detail about Shape Numbers.

8. Explain Regional descriptors.

9. Briefly explain Topological descriptors[May/June 2018].

10. Explain in detail about Patterns and Pattern Classes.

11. Briefly explain about image recognition based Matching[Nov/Dec 2016]

12.Explain in detail about the object recognition Techniques based on matching. [May/June 2017].