QUESTION BANK

UNIT I

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?
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 Tapered Quantization?
If gray levels in a certain range occur frequently while others occurs rarely, the quantization levels are finely spaced in this range and coarsely spaced outside of it. This method is sometimes called Tapered Quantization.

5. What do you meant 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?
1. RGB model
2. CMY model
3. YIQ model
4. HSI model

8. What is Hue of saturation?
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. What is Chromatic Adoption?
The hue of a perceived color depends on the adoption of the viewer. For example, the American Flag will not immediately appear red, white, and blue of the viewer has been subjected to high intensity red light before viewing the flag. The color of the flag will appear to shift in hue toward the red component cyan.

11. Define Resolutions?
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.

12. 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.

13. Define Digital image?
When x, y and the amplitude values of f all are finite discrete quantities , we call the image digital image.

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

15. 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.

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

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

18. What are the types of light receptors?
The two types of light receptors are
1. Cones and
2. Rods

19. 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.

20. 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.

21. Define subjective brightness and brightness adaptation?
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.

22. Define weber ratio
The ratio of increment of illumination to background of illumination is called as weber ratio.(ie) _i/i
If the ratio (_i/i) is small, then small percentage of change in intensity is needed (ie) good brightness adaptation.
If the ratio (_i/i) is large , then large percentage of change in intensity is needed (ie) poor brightness adaptation.

23. What is meant by machband effect?
Machband effect means the intensity of the stripes is constant. Therefore it preserves the brightness pattern near the boundaries, these bands are called as machband effect.

24. What is simultaneous contrast?
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.

25. 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).

26. Define sampling and quantization

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

27. Find the number of bits required to store a 256 X 256 image with 32 gray levels?
32 gray levels = 25
= 5 bits
256 * 256 * 5 = 327680 bits.

28. 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
When M=N, this equation becomes
b=N^2k

30. What do you meant by Zooming 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.

31. What do you meant by shrinking of digital images?
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.

32. 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 N4(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 ND(4).
Eight neighbors of p denoted by N8(P) is a combination of 4 direct neighbors and 4 diagonal neighbors.

33. Explain the types of connectivity.
1. 4 connectivity
2. 8 connectivity
3. M connectivity (mixed connectivity)

34. 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.

35. Give the formula for calculating D4 and D8 distance.
D4 distance (city block distance) is defined by
D4(p, q) = |x-s| + |y-t|
D8 distance(chess board distance) is defined by

$D8(p, q) = \max(|x-s|, |y-t|)$.

36. What is geometric transformation?

Transformation is used to alter the co-ordinate description of image.
The basic geometric transformations are

1. Image translation
2. Scaling
3. Image rotation

37. 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.

38. What is the need for transform?

The need for transform is most of the signals or images are time domain signal (ie) signals can be measured with a function of time. This representation is not always best. For most image processing applications anyone of the mathematical transformation are applied to the signal or images to obtain further information from that signal.

39. Define the term Luminance?

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

40. 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.

41. What are the applications of transform.

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

42. Give the Conditions for perfect transform?

Transpose of matrix = Inverse of a matrix. Orthoganality.

43. What are the properties of unitary transform?

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.

44. Define fourier transform pair?

The fourier transform of f(x) denoted by F(u) is defined by
□
F(u)= _ f(x) e-j2_ux dx ----------------(1)
-□
The inverse fourier transform of f(x) is defined by
□
f(x)= _F(u) ej2_ux dx --------------------(2)
-□
The equations (1) and (2) are known as fourier transform pair.

45. Define fourier spectrum and spectral density?

Fourier spectrum is defined as
F(u) = |F(u)| e j_(u)
Where
|F(u)| = R2(u)+I2(u)
_(u) = tan-1(I(u)/R(u))
Spectral density is defined by
p(u) = |F(u)|2
p(u) = R2(u)+I2(u)

46. Give the relation for 1-D discrete fourier transform pair?

The discrete fourier transform is defined by
n-1
F(u) = 1/N _ f(x) e –j2_ux/N
x=0
The inverse discrete fourier transform is given by
n-1
f(x) = _ F(u) e j2_ux/N
x=0
These equations are known as discrete fourier transform pair.

47. Specify the properties of 2D fourier transform.

The properties are
1. Separability
2. Translation
3. Periodicity and conjugate symmetry
4. Rotation
5. Distributivity and scaling
6. Average value
7. Laplacian
8. Convolution and correlation
9. sampling

48. Explain separability property in 2D fourier transform

The advantage of separable property is that F(u, v) and f(x, y) can be obtained by successive application of 1D fourier transform or its inverse.

n-1
F(u, v) =1/N _ F(x, v) e –j2_ux/N
x=0
Where
n-1
F(x, v)=N[1/N _ f(x, y) e –j2_vy/N
y=0

49. Properties of twiddle factor.

1. Periodicity
WN^(K+N)= WN^K
2. Symmetry
WN^(K+N/2)= -WN^K

50. Give the Properties of one-dimensional DFT

1. The DFT and unitary DFT matrices are symmetric.
2. The extensions of the DFT and unitary DFT of a sequence and their inverse transforms are periodic with period N.
3. The DFT or unitary DFT of a real sequence is conjugate symmetric about N/2.

51. Give the Properties of two-dimensional DFT

1. Symmetric
2. Periodic extensions
3. Sampled Fourier transform
4. Conjugate symmetry.

52. What is meant by convolution?

The convolution of 2 functions is defined by
f(x)*g(x) = f(☐) .g(x- ☐) d☐
where ☐is the dummy variable

53. State convolution theorem for 1D

If f(x) has a fourier transform F(u) and g(x) has a fourier transform G(u) then f(x)*g(x) has a fourier transform F(u).G(u).
Convolution in x domain can be obtained by taking the inverse fourier transform of the product F(u).G(u).
Convolution in frequency domain reduces the multiplication in the x domain
F(x).g(x) _ F(u)* G(u)
These 2 results are referred to the convolution theorem.

54. What is wrap around error?
The individual periods of the convolution will overlap and referred to as wrap around error
55. Give the formula for correlation of 1D continuous function.
The correlation of 2 continuous functions f(x) and g(x) is defined by
f(x) o g(x) = f*(□) g(x+□) d□

56. What are the properties of Haar transform.
1. Haar transform is real and orthogonal.
2. Haar transform is a very fast transform
3. Haar transform has very poor energy compaction for images
4. The basic vectors of Haar matrix sequensly ordered.

57. What are the Properties of Slant transform
1. Slant transform is real and orthogonal.
2. Slant transform is a fast transform
3. Slant transform has very good energy compaction for images
4. The basic vectors of Slant matrix are not sequensely ordered.

58. Specify the properties of forward transformation kernel?
The forward transformation kernel is said to be separable if g(x, y, u, v)
g(x, y, u, v) = g1(x, u).g2(y, v)
The forward transformation kernel is symmetric if g1 is functionally equal to g2
g(x, y, u, v) = g1(x, u). g1(y,v)

59. Define fast Walsh transform.
The Walsh transform is defined by
n-1 x-1
w(u) = 1/N _ f(x) _ (-1) bi(x).bn-1-i (u)
x=0 i=0

60. Give the relation for 1-D DCT.
The 1-D DCT is,
N-1
C(u)=_(u)_ f(x) cos[((2x+1)u_)/2N] where u=0,1,2,….N-1
X=0
N-1
Inverse f(x)= _ _(u) c(u) cos[((2x+1) u_)/2N] where x=0,1,2,…N-1
V=0

61.Write slant transform matrix SN.
SN = 1/_2

62. Define Haar transform.
The Haar transform can be expressed in matrix form as,
T=HFH
Where F = N X N image matrix

H = N X N transformation matrix
T = resulting N X N transform.

UNIT II

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.
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?
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 averagingis 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. 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.

8. Give the formula for negative and log transformation.
Negative: S=L-1-r
Log: S = c log(1+r)
Where c-constant and r 0

9. 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.

10. Define histogram.
The histogram of a digital image with gray levels in the range [0, L-1] is a discrete function h(rk)=nk.
rk-kth gray level nk-number of pixels in the image having gray level rk.

11. What is meant by histogram equalization?
k k
Sk= T(rk) = _ Pr(rj) = _ nj/n where k=0,1,2,….L-1
j=0 j=0
This transformation is called histogram equalization.

12. Differentiate linear spatial filter and non-linear spatial filter.
s.no. Linear spatial filter Non-linear spatial filter
1.
2.
Response is a sum of products of
the filter co-efficient.
R = w(-1,-1) f(x-1,y-1) +
w(-1,0) f(x-1,y) + … +
w(0,0) f(x,y) + … +
w(1,0) f(x+1,y) +
w(1,1) f(x+1,y+1).
They do not explicitly use coefficients
in the sum-of-products.
R = w1z1 + w2z2 + … +w9z9
9
= _ wizi
i=1

13. Give the mask used for high boost filtering.
-1 -1 -1
-1 A+8 -1
-1 -1 -1
0 -1 0
-1 A+4 -1
0 -1 0

14. What is meant by laplacian filter?
The laplacian for a function f(x,y) of 2 variables is defined as,
2 2 2 2 2
f = _ f / _ x + _ f / _ y

15. Write the steps involved in frequency domain filtering.
x+y

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)

16. 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 a distance D0 from the origin is,
2n
H(u,v) = 1 / 1 + [D(u,v) / D0]
2 2 1/2
Where D(u,v) = [(u – M/2) + (v-N/2)]

17. 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.

18. What is Image Negatives?

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

19. Define Derivative filter?

For a function f (x, y), the gradient f at co-ordinate (x, y) is defined as the vector
_f = _f/_x
_f/_y
_f = mag (_f) = {[(_f/_x) 2 +(_f/_y) 2]} ½

20. 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.

21. 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.

22. What is maximum filter and minimum filter?

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

23. Write the application of sharpening filters?
1. Electronic printing and medical imaging to industrial application
2. Autonomous target detection in smart weapons.
24. Name the different types of derivative filters?
1. Perwitt operators
2. Roberts cross gradient operators
3. Sobel operators

UNIT III

1. 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.

2. What are the two properties in Linear Operator?
☐ Additivity
_ Homogenity

3. Explain additivity property in Linear Operator?
H[f1(x,y)+f2(x,y)]=H[f1(x,y)]+H[f2(x,y)]
The additive property says that if H is the linear operator,the response to a sum of two is equal to the sum of the two responses.

4. How a degradation process is modeled?
A system operator H, which together with an additive white noise term _(x,y) a operates on an input image f(x,y) to produce a degraded image g(x,y).

5. Explain homogenity property in Linear Operator?
H[k1f1(x,y)]=k1 H[f1(x,y)]
The homogeneity property says that,the response to a constant multiple of any input is equal to the response to that input multiplied by the same constant.

6. Give the relation for degradation model for continuous function?
g(x,y) =-____f(_,_)§(x-_,y-_).d_d_+_(x,y)

7. What is fredholm integral of first kind?
g(x,y) = __f(_,_)h(x,_,y,_)d_ d_
which is called the superposition or convolution or fredholm integral of first kind. It states that if the response of H to an impulse is known, the response to any input f(_,_)
can be calculated by means of fredholm integral.

8. Define circulant matrix?
A square matrix, in which each row is a circular shift of the preceding row and the first row is a circular shift of the last row, is called circulant matrix.
he(o) he(M-1) he(M-2)………… he(1)
he(1) he(0) he(M-1)………. he(2)

He = ..
he(M-1) he(M-2) he(M-3)………. he(0)
g(x,y)
_(x,y)
H
f(x,y)

9. What is concept algebraic approach?
The concept of algebraic approach is to estimate the original image which minimizes a predefined criterion of performances.

10. What are the two methods of algebraic approach?
o Unconstraint restoration approach
o Constraint restoration approach

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

12. 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.

13. Why the restoration is called as unconstrained restoration?
In the absence of any knowledge about the noise 'n', a meaningful criterion function is to seek an f^ such that H f^ approximates of in a least square sense by assuming the noise term is as small as possible.
Where H = system operator.
f^ = estimated input image.
g = degraded image.

14. 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.

15. What are the three methods of estimating the degradation function?
1. Observation
2. Experimentation
3. Mathematical modeling.

16. What are the types of noise models?
☐ Guassian noise
☐ Rayleigh noise
☐ Erlang noise
☐ Exponential noise
☐ Uniform noise

_ Impulse noise

17. Give the relation for guassian noise?
Guassian noise:
The PDF guassian random variable Z is given by
P(Z)=e-(Z-µ)2/2_2/_2__
Z->Gray level value
_->standard deviation
_2->varianze of Z
µ->mean of the graylevel value Z

18. Give the relation for rayleigh noise?
Rayleigh noise:
The PDF is
P(Z)= 2(z-a)e-(z—a)2/b/b for Z>=a
0 for Z<a
mean µ=a+__b/4
standard deviation _2=b(4-_)/4

19. Give the relation for Gamma noise?
Gamma noise:
The PDF is
P(Z)=ab zb-1 ae-az/(b-1) for Z>=0
0 for Z<0
mean µ=b/a
standard deviation _2=b/a2

20. Give the relation for Exponential noise?
Exponential noise
The PDF is
P(Z)= ae-az Z>=0
0 Z<0
mean µ=1/a
standard deviation _2=1/a2

21. Give the relation for Uniform noise?
Uniform noise:
The PDF is
P(Z)=1/(b-a) if a<=Z<=b
0 otherwise
mean µ=a+b/2
standard deviation _2=(b-a)2/12

22. Give the relation for Impulse noise?
Impulse noise:
The PDF is
P(Z) =Pa for z=a
Pb for z=b

0 Otherwise

23. What is inverse filtering?

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.

F^ (u,v) = G^(u,v)/H(u,v)

24. What is pseudo inverse filter?

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

25. What is meant by least mean square filter?

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 blurr as well as noise.

26. Give the equation for singular value decomposition of an image?

U= m=1_r___m _m

T

This equation is called as singular value decomposition of an image.

27. Write the properties of Singular value Decomposition(SVD)?

☐ The SVD transform varies drastically from image to image.

☐ The SVD transform gives best energy packing efficiency for any given image.

☐ The SVD transform is useful in the design of filters finding least square,minimum solution of linear equation and finding rank of large matrices.

28. What is meant by 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.

29. What are the two approaches for blind image restoration?

☐ Direct measurement

_ Indirect estimation

30. What is meant by Direct measurement?

In direct measurement the blur impulse response and noise levels are first estimated from an observed image where this parameter are utilized in the restoration.

31. What is blur impulse response and noise levels?

Blur impulse response: This parameter is measured by isolating an image of a suspected object within a picture.
Noise levels: The noise of an observed image can be estimated by measuring the image covariance over a region of constant background luminence.

32. What is meant by indirect estimation?

Indirect estimation method employ temporal or spatial averaging to either obtain a restoration or to obtain key elements of an image restoration algorithm.

33. 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.
Where as Removal of image blur by applying a deblurrings function is considered a restoration technique.

UNIT IV

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?

☐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.
☐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 digitised voice where losses outside visual or aural perception can be tolerated.

4. What is the need for Compression?

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 decompresses it when it is retrieved.
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.
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.

5. What are different Compression Methods?

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

6. Define is coding redundancy?

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.

7. 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

8. What is run length coding?

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:

9. Define compression ratio.

Compression Ratio = original size / compressed size: 1

10. 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.

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 source encoder

Source encoder performs three operations
1) Mapper -this transforms the input data into non-visual format. It reduces the interpixel redundancy.
2) Quantizer - It reduces the psycho visual redundancy of the input images .This step is omitted if the system is error free.
3) Symbol encoder- This reduces the coding redundancy .This is the final stage of encoding process.

13. Define channel encoder

The channel encoder reduces reduces the impact of the channel noise by inserting

redundant bits into the source encoded data.
Eg: Hamming code

14. What are the types of decoder?
Source decoder- has two components
a) Symbol decoder- This performs inverse operation of symbol encoder.
b) Inverse mapping- This performs inverse operation of mapper.
Channel decoder-this is omitted if the system is error free.

15. What are the operations performed by error free compression?
1) Devising an alternative representation of the image in which its interpixel redundant are reduced.
2) Coding the representation to eliminate coding redundancy

16. 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.

17. Define Huffman coding
☐Huffman coding is a popular technique for removing coding redundancy.
☐When coding the symbols of an information source the Huffman code yields the smallest possible number of code words, code symbols per source symbol.

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

19. Define instantaneous code
A code word that is not a prefix of any other code word is called instantaneous or prefix codeword.

20. Define uniquely decodable code
A code word that is not a combination of any other codeword is said to be uniquely decodable code.

21. 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

22. Define the procedure for Huffman shift
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.

23. 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.

24. 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.

25. What are three categories of constant area coding?

The three categories of constant area coding are

☐All white
☐All black
☐Mixed intensity.

The most probable or frequency occurring is assign a 1 bit code '0', other two categories area assigned as 2 bit code '10' and '11'

27. How effectiveness of quantization can be improved?

☐Introducing an enlarged quantization interval around zero, called a dead zero.
☐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.

28. What are the coding systems in JPEG?

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.

29. 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,...

30. What are the basic steps in JPEG?

The Major Steps in JPEG Coding involve:

_ DCT (Discrete Cosine Transformation)
_ Quantization
_ Zigzag Scan

_ DPCM on DC component
_ RLE on AC Components
_ Entropy Coding

31. 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
Input image Wavelet transform Quantizer Symbol
encoder
Symbol
decoder
Inverse wavelet
transform
Compressed
image
Compressed image
Decompressed
Image

32. Draw the JPEG Encoder.

33. Draw the JPEG Decoder.

34. What is zig zag sequence?

The purpose of the Zig-zag Scan:
_ To group low frequency coefficients in top of vector.
_ Maps 8 x 8 to a 1 x 64 vector

35. 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.

36. 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

37. 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.

UNIT V

1. What is segmentation?
Segmentation subdivides on image in to its constitute regions or objects. The level to which the subdivides is carried depends on the problem being solved .That is segmentation should when the objects of interest in application have been isolated.

2. Write the applications of segmentation.
* Detection of isolated points.
* Detection of lines and edges in an image.

3. What are the three types of discontinuity in digital image?
Points, lines and edges.

4. How the derivatives are obtained in edge detection during formulation?
The first derivative at any point in an image is obtained by using the magnitude of the gradient at that point. Similarly the second derivatives are obtained by using the laplacian.

5. Write about linking edge points.
The approach for linking edge points is to analyze the characteristics of pixels in a small neighborhood (3x3 or 5x5) about every point (x,y)in an image that has undergone edge detection. All points that are similar are linked, forming a boundary of pixels that share some common properties.

6. What are the two 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.

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

8. Give the properties of the second derivative around an edge?
* 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 straightline joining the extreme positive and negative values of the second derivative would cross zero near the midpoint of the edge.

9. Define Gradient Operator?

First order derivatives of a digital image are based on various approximation of the 2-D gradient. The gradient of an image f(x,y) at location(x,y) is defined as the vector

Magnitude of the vector is

_f=mag(_f)=[Gx2+ Gy2]1/2

_(x,y)=tan-1(Gy/Gx)

_(x,y) is the direction angle of vector _f

10. What is meant by object point and background point?

To execute the objects from the background is to select a threshold T that separate these modes. Then any point (x,y) for which f(x,y)>T is called an object point. Otherwise the point is called background point.

11. What is global, Local and dynamic or adaptive threshold?

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

12. Define region growing?

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 neighbouring pixels that have properties similar to the seed.

13. Specify the steps involved in splitting and merging?

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.

14. 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.

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

The two steps are

1. Preprocessing
2. Definition of a set of criteria that markers must satisfy.

16. Define chain codes?

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 the segments . The direction of each segment is coded by using a numbering scheme.

17. What are the demerits of chain code?
* The resulting chain code tends to be quite long.
* 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.

18. What is thinning or skeletonizing algorithm?
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 play a central role in a broad range of problems in image processing, ranging from automated inspection of printed circuit boards to counting of asbestos fibres in air filter.

19. Specify the various image representation approaches
☐Chain codes
☐Polygonal approximation
☐Boundary segments

20. What is polygonal approximation method ?
Polygonal approximation is a image representation approach in which a digital boundary can be approximated with arbitary 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.

21. Specify the various polygonal approximation methods
☐Minimum perimeter polygons
☐Merging techniques
☐Splitting techniques

22. Name few boundary descriptors
☐Simple descriptors
☐Shape numbers
☐Fourier descriptors

23. 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

24. Define length of a boundary.
The length of a boundary is the number of pixels along a boundary.Eg.for a chain coded curve with unit spacing in both directions the number of vertical and horizontal components plus _2 times the number of diagonal components gives its exact length.

25. 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.

26. 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.

27. Describe Fourier descriptors
Fourier descriptor of a boundary can be defined as
K-1
a(u)=1/K_s(k)e-j2_uk/K
k=0
for u=0,1,2……K-1.The complex coefficients a(u) are called Fourier descriptor of a boundary.
The inverse Fourier descriptor is
K-1
s(k)= _ a(u)ej2_uk/K
u=0
for k=0,1,2,……K-1

28. Give the Fourier descriptors for the following transformations
(1)Identity (2)Rotation (3)Translation (4)Scaling (5)Starting point
(1)Identity – a(u)
(2)Rotation -ar(u)= a(u)ej_
(3) Translation-at(u)=a(u)+_xy_(u)
(4)Scaling-as(u)=_a(u)
(5)Starting point-ap(u)=a(u)e-j2_uk
0
/K

29. Specify the types of regional descriptors
☐Simple descriptors
☐Texture

30. Name few measures used as simple descriptors in region descriptors
☐Area
☐Perimeter
☐Compactness
☐Mean and median of gray levels
☐Minimum and maximum of gray levels
☐Number of pixels with values above and below mean
☐

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

32. Describe texture

Texture is one of the regional descriptors. It provides measures of properties such as smoothness, coarseness and regularity. There are 3 approaches used to describe texture of a region.

They are:

☐Statistical
☐Structural
☐Spectral

33. 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.

34. 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 co-occurrence matrix if C depends on P,the presence of given texture patterns may be detected by choosing an appropriate position operator.

35. Explain structural and spectral approach

Structural approach deals with the arrangement of image primitives such as description of texture based on regularly spaced parallel lines.

Spectral approach is based on properties of the Fourier spectrum and are 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:

☐Prominent peaks in spectrum gives the principal direction of texture patterns.
☐The location of peaks in frequency plane gives fundamental spatial period of patterns.
☐Eliminating any periodic components by our filtering leaves non- periodic image elements.

16 MARKS

UNIT I

1. Explain the steps involved in digital image processing.
(or)
Explain various functional block of digital image processing

Image acquisition
Preprocessing
Segmentation
Representation and Description
Recognition and Interpretation

2. Describe the elements of visual perception.

Cornea and Sclera
Choroid – Iris diaphragm and Ciliary body
Retina- Cones and Rods

3. Describe image formation in the eye with brightness adaptation and discrimination

Brightness adaptation
Subjective brightness
Weber ratio
#Mach band effect
#simultaneous contrast

4. Write short notes on sampling and quantization.

Sampling
Quantization
Representing Digital Images

5. Describe the functions of elements of digital image processing system with a diagram.

Acquisition
Storage
Processing
Communication
Display

6. Explain the basic relationships between pixels?

Neighbors of a pixel
Connectivity, Adjacency, Path

Distance Measure
Arithmetic and Logic Operations

7. Explain the properties of 2D Fourier Transform.
Separability
Translation
Periodicity and Conjugate Symmetry
Rotation
Distribution and Scaling
Average Value
Laplacian
Convolution and correlation
Sampling

8. (i)Explain convolution property in 2D fourier transform.
* 1D Continuous
* 1D Discrete
* 1D convolution theorem
* 2D continuous
* 2D Discrete
* 2D convolution theorem

(ii) Find F (u) and |F (u)|
9. Explain Fast Fourier Transform (FFT) in detail.
FFT Algorithm
FFT Implementation

10. Explain in detail the different separable transforms
Forward 1D DFT & 2D DFT
Inverse 1D DFT & 2D DFT
Properties

11. Explain Hadamard transformation in detail.
1D DHT
1D Inverse DHT
2D DHT
2D Inverse DHT

12. Discuss the properties and applications of
1)Hadamard transform 2)Hotelling transform
Properties of hadamard:
Real and orthogonal
fast transform
faster than sine transform
Good energy compaction for image
Appl:
Image data compression,

filtering and design of course
Properties of hotelling:
Real and orthogonal
Not a fast transform
Best energy compaction for image
Appl:
Useful in performance evaluation & for finding performance
Bounds

13. Explain Haar transform in detail.
Def P= 2P+q-1
Find h k (z)

14. Explain K-L transform in detail.
Consider a set of n or multi-dimensional discrete signal represented as column vector x1,x2,…xn each having M elements,
X1
X2
X= .
.
Xn
The mean vector is defined as Mx=E{x}
Where E{x} is the expected value of x. M
For M vector samples mean vector is Mx=1/M _ Xk
K=1
T
The co-variant matrix is, Cx=E{(X-Mx)(X-Mx)}
M T
For M samples, Cx=1/M _ (xk-Mx)(xk-Mx).
K=1
K-L Transform Y= A (X- MX)

UNIT II

1. Explain the types of gray level transformation used for image enhancement.
Linear (Negative and Identity)
Logarithmic(Log and Inverse Log)
Power_law (nth root and nth power)
Piecewise_linear (Constrast Stretching, Gray level Slicing,
Bit plane Slicing)

2. What is histogram? Explain histogram equalization.
P(rk) = nk/n
Ps(s) = 1 means histogram is arranged uniformly.

3. Discuss the image smoothing filter with its model in the spatial domain.
LPF-blurring

Median filter – noise reduction & for sharpening image

4. What are image sharpening filters. Explain the various types of it.
used for highlighting fine details
HPF-output gets sharpen and background becomes darker
High boost- output gets sharpen but background remains unchanged
Derivative- First and Second order derivatives
Appl:
Medical image
electronic printing
industrial inspection

5. Explain spatial filtering in image enhancement.
Basics
Smoothing filters
Sharpening filters

6. Explain image enhancement in the frequency domain.
Smoothing filters
Sharpening filters
Homomorphic filtering

7. Explain Homomorphic filtering in detail.
f(x, y) = i(x, y) . r(x, y)
Calculate the enhanced image g(x,y)

UNIT III

1. Explain the algebra approach in image restoration.
Unconstrained
Constrained

2. What is the use of wiener filter in image restoration. Explain.
Calculate f^
Calculate F^(u, v)

3. What is meant by Inverse filtering? Explain.
Recovering i/p from its o/p
Calculate f^(x, y)
4. Explain singular value decomposition and specify its properties.
U= m=1_r___m _m
T
This equation is called as singular value decomposition of an image.
Properties
☐The SVD transform varies drastically from image to image.
☐The SVD transform gives best energy packing efficiency for any given

image.
☐The SVD transform is useful in the design of filters finding least square,minimum solution of linear equation and finding rank of large matrices.

5. Explain image degradation model /restoration process in detail.

Image degradation model /restoration process diagram
Degradation model for Continuous function
Degradation model for Discrete function – 1_D and 2_D

6. What are the two approaches for blind image restoration? Explain in detail.

_ Direct measurement
_ Indirect estimation

UNIT IV

1. What is data redundancy? Explain three basic data redundancy?

Definition of data redundancy
The 3 basic data redundancy are
_ Coding redundancy
_ Interpixel redundancy
_ Psycho visual redundancy

2. What is image compression? Explain any four variable length coding compression schemes.

☐Definition of image compression
☐Variable Length Coding
* Huffman coding
* B2 Code
* Huffman shift
* Huffman Truncated
* Binary Shift
*Arithmetic coding

3. Explain about Image compression model?

☐The source Encoder and Decoder
☐The channel Encoder and Decoder

4. Explain about Error free Compression?

a. Variable Length coding
i. Huffman coding
ii. Arithmetic coding
b. LZW coding
c. Bit Plane coding
d. Lossless Predictive coding

5. Explain about Lossy compression?

☐Lossy predictive coding

☐Transform coding
☐Wavelet coding

6. Explain the schematics of image compression standard JPEG.
☐Lossy baseline coding system
☐Extended coding system
☐Lossless Independent coding system

7. Explain how compression is achieved in transform coding and explain about DCT
_ Block diagram of encoder
_ decoder
_ Bit allocation
_ 1D transform coding
_ 2D transform coding, application
_ 1D,2D DCT

8. Explain arithmetic coding
_ Non-block code
_ One example

9. Explain about Image compression standards?
_ Binary Image compression standards
_ Continuous tone still Image compression standards
_ Video compression standards

10. Discuss about MPEG standard and compare with JPEG
_ Motion Picture Experts Group
1. MPEG-1
2. MPEG-2
3. MPEG-4
_ Block diagram
_ I-frame
_ p-frame
_ B-frame

UNIT V

1. What is image segmentation. Explain in detail.
☐Definition - image segmentation
☐Discontinity – Point, Line, Edge
☐Similarity – Thresholding, Region Growing, Splitting and Merging

2. Explain Edge Detection in details?
* Basic formation.
* Gradient Operators

* Laplacian Operators

3. Define Thresholding and explain the various methods of thresholding in detail?

☐Foundation
☐The role of illumination
☐Basic adaptive thresholding
☐Basic adaptive thresholding
☐Optimal global & adaptive thresholding.

4. Discuss about region based image segmentation techniques. Compare threshold region based techniques.

* Region Growing
* Region splitting and merging
* Comparison

5. Define and explain the various representation approaches?

☐chain codes
☐Polygon approximations
☐Signature
☐Boundary segments
☐Skeletons.

6. Explain Boundary descriptors.

☐Simple descriptors.
☐Fourier descriptors.

7. Explain regional descriptors

☐Simple descriptors
☐Texture
i. Statistical approach
ii. Structural approach
iii. Spectral approach

8. Explain the two techniques of region representation.

_ Chain codes
_ Polygonol approximation

9. Explain the segmentation techniques that are based on finding the regions directly.

_ Edge detection line detection
_ Region growing
_ Region splitting
_ region merging

10. How is line detected? Explain through the operators

_ Types of line masks

1. horizontal
2. vertical
3. +45°,-45°

QUESTION BANK

DIGITAL IMAGE PROCESSING

2 MARKS

UNIT I

1. Fundamental steps in DIP.
2. Components of DIP.
3. Mass storage types.
4. Retina – Types of light receptors cones/rods.
5. Brightness adaptation and discrimination.
6. Weber ratio.
7. Simultaneous contrast.
8. Image sampling and quantization.
9. Neighbor of pixel, adjacency, connectivity, distance.
10. Brightness, hue, saturation, intensity, radiance and luminance.
11. Gray level of image.
12. Digital image and application of DIP.
13. Blind spot.
14. Spatial and intensity level resolution.

UNIT II

1. Gray level transformation.
2. Contrast stretching.
3. Bit plane slicing.
4. Histogram, equalization matching/specification.
5. Median
6. Min/max
7. First order derivative
8. Second order derivative.
9. Image enhancement and its types.
10. Spatial filtering
11. Frequency filtering.
12. Weighted average filter.
13. Homomorphic filter.
14. Spatial and frequency domain method.

15. Order statistic filter.

UNIT III

1. Restoration/enhancement.
2. Model.
3. Noise models.
4. Mean Filter
5. Order statistics filter.
6. Adaptive filter.
7. Notch filter.
8. Inverse
9. Mean square filter.
10. Segmentation.
11. Rotation of discontinuities.
12. Edge.
13. Region based segmentation.
14. Erosion and dilation.
15. Morphological processing.

UNIT IV

1. Wavelets.
2. Image pyramids.
3. HAAR transform.
4. Coding.
5. Image compression types.
6. Data redundancy and its types.
7. Compression model.
8. Need for compression.
9. Huffman coding and its limitations.
10. Arithmetic coding.
11. JPEG, MPEG.
12. Huffman/Arithmetic/LZW.

UNIT V

1. Channel code.
2. Texture
3. Pattern/pattern
4. Polygonal apex method.
5. Regional description
6. Boundary description.
7. Shape

8. Pattern recognition.
9. Statistical moments.
10. Advantages of statistics.
11. Pattern
12. Minimum distance classifier.
13. String description.

16 MARKS

UNIT I

1. ORIGIN IN DIP
2. **STEPS IN IMAGE PROCESSING**
3. **COMPONENTS IN IMAGE PROCESSING**
4. **ELEMETS OF VISUAL PRECEPTION**
5. **IMAGE SENSING AND ACQUISTION**
6. **IMAGE SAMPLING AND QUANTIZATION**
7. **RELATION SHIP BETWEEN PIXELS**
8. COLOUR MODELS

UNIT II

1. **GRAY LEVEL TRANSFORMATION**
2. **HISTOGRAM**
3. **SPATIAL DOMAIN FILTERING**
4. **FREQUNCY DOMAIN FILTERING**
5. **HOMOMORPHIC FILTERING**
6. FOURIER TRANSFORM AND PROPERTIES

UNIT III

1. **NOISE MODELS**
2. **MEAN FILTERS , ORDER STATICS FILTER**
3. **BAND FILTERS NOTCH FILTER,OPTIUM NOTCH**
4. **INVERSE, WEINER**
5. DETECTION OF DISCONTINUITY
6. EDGE LINKING AND BOUNDARYDETECTION

7. **REGION BASED SEGMENTATION**
8. **MORPHOLOGIACL PROCESSING & EROSION & DILATION**

UNIT IV

1. WAVELETS
2. **SUBBAND CODING**
3. MULTI RESOLUTION EXPANSION
4. **IMAGE COMPRESION MODEL**
5. **VARIABLE LENGTH CODING**
    a. **HUFFMANN CODING**
    b. **ARITHMETIC CODING**
6. **BIT PLANE CODING**
7. **LOSSY AND LOASLESS PREDICTIVE CODING**
8. **JPEG AND MPEG**

UNIT V

1. BOUNDARY REPRESENTATION
2. CHAIN CODE, SIGNATURE, POLYGONAL APPROXIMATION
3. **BOUNDARY DISCRIPTORS**
4. **REGIOANL DISCRIPTORS**
5. **TEXTURE**
6. **PATTERNA ND PATTERN CLASSES**
7. **RECOGINITION BASED ON MATCHING**