K.S.R. COLLEGE OF ENGINEERING (Autonomous), TIRUCHENGODE – 637 215.
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE / LESSON PLAN SCHEDULE

NAME : Dr.S.KARTHIKEYAN, Mr.R.MAHENDRAN
CLASS : III - ECE (A & B SECTIONS)
SUBJECT CODE / SUBJECT NAME: 16EC713 / DIGITAL IMAGE PROCESSING

A.TEXT BOOKS:

T1 Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education – Inc – 3rd Edition, Third impression, 2011.

T2 Jaya Raman S, Esakkirajan S, Veerakumar. T, "Digital Image Processing", TMH, 2010.

B. REFERENCE BOOKS:

R1 Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson/Prentice Hall of India – 2002.

R2 Kenneth R.Castleman- "Digital Image Processing"-Pearson, 2nd reprint-2008

R3 William K Pratt, "Digital Image Processing John Willey",John Wiley, 2002.

R4 David Salomon, "Data Compression – The Complete Reference", Springer – Verlag, 2nd Edition, PHI 2011.

R5 http://nptel.ac.in/courses/117105079/

C. LEGEND:

L – Lecture BB – Black Board OHP – Overhead Projector Tx/Rx – Text/Reference Books
LCD – Liquid Crystal Display Projector pp – Pages

Sl.No	Lecture Hour	Topic(s) to be covered	Teaching Aid Required	Book No. / Page No.
		UNIT I -DIGITAL IMAGE FUNDAMENTALS		
1.	L1	Elements of Digital Image Processing systems	BB	T1(28-30), T2(22-38) R2(2-6),
2.	L2	Elements of Visual Perception,	BB	T1(36-43),T2(14-19) R3(23-33),
3.	L3	Basic relationship between pixels, Connectivity	PPT	T1(68-71),
4.	L4	Distance Measures, Brightness, Contrast	BB	T1(71-72), T1(396),R1(73), R3(25&35),
5.	L5	Hue, Saturation, Mach band effect	BB	T1(41,396), T2(14-19), R1(75-76), R3(32),
6.	L6	Color image fundamentals – RGB model	PPT	T1(395-407),R2(547-555),
7.	L7	HSI model, Conversion from RGB to HIS	BB	T1(407-414), R2(547-555), R4(303-314),
8.	L8	Image Sampling - Quantization	BB	T1(52-68),T2(4-13), R1(102-145), R3(149-157),
9.	L9	Dither, **Fundamental steps in Digital Image Processing**		T1(25-28), R1(142),
		UNIT II- IMAGE TRANSFORMS		
10.	L10	2D Transforms – DFT	BB	T1(236-254), T2(155-174), R1(167-175) R3(10-15),R5(21-27), R3(189-195)
11.	L11	2D – Discrete Cosine Transform (DCT)	BB	T2(194-202), R3(196)
12.	L12	Discrete Sine Transform (DST)	BB	R1(176-177), R3(196-199)
13.	L13	Walsh Transform	BB	T2(175-181)
14.	L14	Hadamard Transform, Slant Transform	BB	R1(177-181), R1(183-185), R3(200-203)
15.	L15	Haar Transform	BB	R1(181-183), R3(203-206)
16.	L16	DWT: Haar Wavelet	BB	T1(474-476)
17.	L17	Daubechies Wavelet Transform	BB	http://bearcave.com/misl/misl_tech/wavelets/daubechies/index.html
18.	L18	CWT: Hermitian wavelet, poisson wavelet transform - **Multiwavelet Transform**	PPT	https://journals.ametsoc.org/doi/full/10.1175/2009JTECHA1338.1

UNIT III - IMAGE ENHANCEMENT AND RESTORATION				
19.	L19	Spatial domain enhancement: Gray level transformations, Histogram modification and specification techniques	BB	T1(120-144) T2(244-260),R1(257-266), R3(243-297), R3(253-260), R4(47-61),
20.	L20	Image averaging - Directional Smoothing	BB	R1(266-268), R4(63-74),
21.	L21	Median - Geometric mean - Harmonic mean - Contra harmonic mean filters	BB	T1(156), T1(323-326), T2(270-272),R1(268-274), R4(74-82),
22.	L22	Homomorphic filtering, Color image enhancement	BB	T1(289-294), T2(292-293), T2(584-606),R1(581-282), R1(284-285), R2(540-560), R3(284-289),
23.	L23	Image Restoration: Degradation model	BB	T1(312-313), T2(324-340),R3(297-318), R4(164-165),
24.	L24	Unconstrained restoration and Constrained restoration	PPT	T1(357-360), R1(319-320),R3(358-362), R4(198-200),
25.	L25	Inverse filtering	BB	T1(351-352),R1(297-298), R4(194),
26.	L26	Wiener filtering	BB	T1(352-357),R1(298-300), R4(194-198),
27.	L27	Geometric Transformations, **Image Reconstruction**	BB	T1(87-92), R1(30-31), R2(115-137), R4(242-245),
UNIT IV - IMAGE SEGMENTATION AND REPRESENTATION				
28.	L28, L29	Line , Point and Edge detections	BB	T1(692-737),T2(368-369),R1(377-379) R2(465-466), R4(490-503),R5(239-241) R3(443-506)
29.	L30	Edge linking via Hough transform	BB	T1(725-737), T2(391-393), R1(384), R2(466-468), R4(503-511)
30.	L31	Morphological operation	PPT	T1(627-678), T2(548-554),R3(435-439),R5(252-254), R4(444-454)
31.	L32	Thresholding	BB	T1(738-762),T2(379-380),R2(452-460), R4(511-532)
32.	L33	Region based segmentation: Region growing, Region splitting and merging	BB	T1(763-768),T2(369-376),R1(434-435), R2(468-469),R3(562-565), R4(532-542)
33.	L34	Image representation: Chain codes	BB	T1(798-800), R1(385), R4(562-564),
34.	L35	Signatures, Boundary segments	BB	T1(808-811), R4(573-577)
35.	**L36**	Skeletons, **Water Shed Segmentation Algorithm**	BB	T1(812-814), T1(774-775), R1(404-410), R4(577-579)
UNIT V - IMAGE COMPRESSION				
36.	L37,L38	Need for data compression, Loss less compression: Run length coding	BB	T1(553-558),T2(444-445), T2(449-450),R1(499), R1(562-567), R2(433)
37.	L39	Huffman Coding		T1(542-544)
38.	L40	Bit plane coding	BB	T1(562-565),R1(505),
39.	L41	LZW coding	BB	T1(551-552), T2(469-470),R2(433)
40.	L42	Lossy compression: Vector quantization	BB	T2(497-505)
41.	L43,L44	Block Truncation coding, Applications: Satellite Image Processing	BB	T2(511-515)
42.	L45	Image forensic science **Digital Image Watermarking**	BB	T1(614-620), T1(542-544),T2(459-460),R2(434)

UNIT I - DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS (CO1)

Part-A (2 Marks)

1. **Define Image?(Remembering)**
   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?(Remembering)**
   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 and contrast of images? (Remembering)**
   Brightness of an object is the perceived luminance of the surround. Two objects with different surroundings would have identical luminance but different brightness.
4. **What do you meant by Gray level?(Remembering)**
   Gray level refers to a scalar measure of intensity that ranges from black to grays and finally to white.
5. **Define Resolutions?(Remembering)**
   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.
6. **What is meant by pixel?(Remembering)**
   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.
7. **Define Digital image?(Remembering)**
   When x, y and the amplitude values of f all are finite discrete quantities, we call the image digital image.
8. **What are the steps involved in DIP? (Remembering)**
   1. Image Acquisition
   2. Preprocessing
   3. Segmentation
   4. Representation and Description
   5. Recognition and Interpretation
9. **What is recognition and Interpretation?(Remembering)**
   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.
10. **Specify the major components or elements of DIP system.(Understanding)**
    1. Image Acquisition 2. Storage 3.Processing 4. Display
11. **What are the applications of image processing?(Remembering)**
    1) Remote sensing,2) Image transmission and Storage .3) Medical Image processing 4)Radar 5) Sonar 6)Robotics, etc.,
12. **What are the types of light receptors?(Remembering)**
    The two types of light receptors are 1. Cones 2. Rods
    In each eye, cones are in the range 6-7 million and rods are in the range 75-150 million
13. **Differentiate photopic and scotopic vision? (Understanding)**

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.	Several rods are connected to one nerve end. So it gives the overall picture of the image.
2. This is also known as bright light vision.	This is also known as thin light vision.

14. **Define subjective brightness and brightness adaptation?(Remembering)**
    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.
15. **Define Weber ratio. What does it indicate? (Remembering)**
    - The ratio of increment of illumination to background of illumination is called asWeber ratio.(ie) $\Delta i/i$.

- If the ratio (Δi/i) is small, then small percentage of change in intensity is needed (ie) good brightness adaptation.
- If the ratio (Δi/i) is large, then large percentage of change in intensity is needed (ie) poor brightness adaptation. Weber ratio indicates brightness adaptation.

16. **What is meant by mach band effect?(Remembering) (June 2017,2018, May 2019)**
Mach band effect means the intensity of the stripes is constant. Therefore it preserves the brightness pattern near the boundaries; these bands are called as mach band effect.

17. **Define optical illusion. (Remembering) (June 2018)**
It is characterized by visually perceived images that are deceptive or misleading. The information gathered by the eye is processed by the brain to give a perception that does not tally with physical measurements of the stimulus source.

18. **What is simultaneous contrast?(Remembering)**
The region reserved brightness not depends on its intensity but also on its background. All centres square have same intensity. However they appear to the eye to become darker as the background becomes lighter.

19. **What is meant by illumination and reflectance?(Remembering)**
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).

20. **Write the expression to find the number of bits to store a digital image?(Understanding)**
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

21. **Find the number of bits required to store a 256 X 256 image with 32 gray level.(Applying)**
32 gray levels= 2^5= 5 bits, 256 x 256 x 5 = 327680 bits.

22. **What do you meant by Zooming of digital images?(Remembering)**
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.

23. **What do you meant by shrinking of digital images?(Remembering)**
Shrinking may be viewed as under sampling. To shrink an image by one half, V delete every row and column. To reduce possible aliasing effect, it is a good idea to bit an image slightly before shrinking it.

24. **Write short notes on neighbors of a pixel.(Remembering)**
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-I, 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 at4 diagonal neighbors.

25. **Mention the types of connectivity.(Remembering)**
1). 4 connectivity 2).8 connectivity 3). M connectivity (mixed connectivity)

26. **What is meant by path?(Remembering)**
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.

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

28. **Give the matrix form of an MxN digital image.(Understanding)**

$$f(x,y) = \begin{pmatrix} f(0,0) & f(0,1) \ldots & f(0,N-1) \\ f(1,0) & f(1,1) \ldots & f(1,N-1) \\ . & . & . \\ . & . & . \\ f(M-1,0) & f(M-1,1) & \ldots & f(M-1,N-1) \end{pmatrix}$$

Right side of the equation is by definition a digital image. Each element of this matrix array is called an image element, picture element, pixel or pel.

29. **How would you represent a image in terms of light and reflectance level.(Remembering)**
G(x,y)=i(x,y)r(x,y) , where G(x,y) is image, i(x,y)is light and r(x,y) reflectance level

30. What is false contouring?(Remembering)

The effect caused by the use of an insufficient number of gray levels in smooth areas of a digital image is called false contouring.

31. Define Sampling and quantization. (Remembering)

Sampling and Quantization are process of discretizing a continuous image**.**

Sampling is the process of discretizing the continuous image along spatial co-ordinate directions. It involves taking samples along the spatial co-ordinate directions at periodic intervals.

Quantization is the process of discretizing the values of these samples. It involves converting the intensity values of the samples into discrete intensity levels.

32. Define Tapered Quantization? Or when fine sampling and coarse sampling used? (Remembering)

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.

33. State 2-D sampling theorem.(Remembering)

A band limited function f(x,y) sampled uniformly with spacing Δx, Δy can be recovered without error from sample values provided the sampling rate is greater than the Nyquiest rate.

$$\frac{1}{\Delta x} = \boldsymbol{\varepsilon_{xs}} > 2\boldsymbol{\varepsilon_{x0}}, \frac{1}{\Delta y} = \boldsymbol{\varepsilon_{ys}} > 2\boldsymbol{\varepsilon_{y0}}$$

34. What are Nyquist rate?(Remembering)

The lower bounds on the sampling rates, i.e. $\boldsymbol{2\varepsilon_{x0}}$, $\boldsymbol{2\varepsilon_{y0}}$, are called the Nyquist rates or Nyquist frequencies where $\boldsymbol{\varepsilon_{x0}}$ and $\boldsymbol{\varepsilon_{y0}}$ are *x* and *y* bandwidths of the image.

35. What do you mean by fold over frequency?(Remembering)

The frequency above half the sampling frequencies $\boldsymbol{\varepsilon_{xs}}$ and $\boldsymbol{\varepsilon_{ys}}$ i.e above $\frac{\varepsilon_{xs}}{2}, \frac{\varepsilon_{ys}}{2}$ are called fold over frequencies.

36. State the meaning for the term aliasing.(Remembering)

The overlapping successive periods of the spectrum causes the fold over frequencies in original image to appear as frequencies below $\frac{\varepsilon_{xs}}{2}, \frac{\varepsilon_{ys}}{2}$ in the sampled image. This is called aliasing.

37. What are the major components of visual perception?(Remembering)

1. Brightness 2. Color 3. Edges

38. Write short notes on three perceptual attributes of color.(Remembering)

- The human Visual System tends to perceive color as being made up of varying amounts of red, green, and blue. That is human vision is particularly sensitive to these colors. This a function of the cone cells in the retina of the eye. These values are called the primary colors. If we add together any two primary colors we obtain the secondary colors.
- Megenta (purple) = red+ blue 2.Cyan = green+ blue. 3.Yellow= red+ blue.
- The amounts of red, green, and blue that make up a given color can be determined by a color matching experiment.

39. What do you meant by Color model?(Remembering)

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.

40. List the hardware oriented color models?(Remembering)

I. RGB model 2. CMY model 3. YIQ model 4. HSI model

41. What is Hue, saturation?(Remembering)

Hue is a color attribute that describes a pure color where saturation gives ameasure of the degree to which a pure color is diluted by white light.

42. List the applications of color models?(Remembering)

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

43. What is Chromatic Adoption?(Remembering)

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.

44. What is Lloyd-Max quantizer?(Remembering)

The Optimum Mean Square quantizer is called Lloyd-Max quantizer. This quantizer minimizes the mean square error for a given number of quantization level.

45. What is meant by Dither?(Remembering) (June 2018)

A method of suppressing contouring effect is to add a small amount of uniformly distributed pseudorandom noise to the luminance samples before quantization. This pseudorandom noise is also called dither. Dithering in general terms, refers to the process of reducing the number of colors in an image.

46. Define spatial and Gray level resolution. (Remembering) (May 2019)

Spatial resolution: It is determined by sampling and defined as smallest discernible details in image.

Gray level resolution: It is defined as smallest discernible changes in image.

47. Mention the difference between monochrome and grey scale image. (Remembering)

Monochrome image	grey scale image
Monochrome image have only black and white color	Gray image represent by black and white shades or combination of colors
Its intensity level is 0 and 1	Its intensity level range from 0 to 255

48. Compare RGB and HIS color models.(Understanding)

RGB model	HIS model
Primarily used for displays and cameras	Useful for human interpretation
Three axis represent intensity of green, blue and red.	Three axis represent hue, saturation and intensity
RGB is great for colour generation	HSI is great for colour description

49. Find the number of bits required to store a 256 X 256 image with 8 bit representation. (Applying) (June 2017)

8 bits = 2^3= 3 bits, 256 x 256 x 3 = 196608 bits.

Part-B (12 Marks questions)

1. Explain the steps involved in digital image processing. (or) Explain various functional block or elements or components of digital image processing and describe its functions? **(Understanding) (June 2017, 2018, May 2019)**
2. Describe the elements of visual perception.**(Remembering)**
3. Describe image formation in the eye with brightness adaptation and discrimination. **(Understanding)**
4. Explain any four basic relationships between pixels?**(Understanding) (June 2017, 2018)**
5. To create a digital image, from an output of a sensor, discuss the various processes to be performed. **(Understanding)**
6. Discuss the effects of non uniform sampling and quantization. **(Understanding) (May 2019)**
7. Explain the various Image sensing and Acquisition methods. **(Understanding)**
8. Discuss about the connectivity and distance measures between pixels of an image. **(Understanding)**
9. Explain the basic concept of image sampling and quantization with neat sketch. **(Understanding) (June 2017)**
10. State sampling theorem and give the equation for the reconstructed image. Discuss in detail the image sampling and reconstruction. Also explain the aliasing problem and the sampling theorem **(Understanding)**
11. Derive Lloyd – Max Quantizer (LMQ) equation to minimize distortion of image and prove the signal to noise ratio achieved by the Lloyd – Max Quantizer for uniform distribution is 6 dB per bit. Also define the three properties of LMQ and show their proofs. **(Applying)**
12. Demonstrate the use of RGB colour model and its conversion from one to another. **(Understanding) (June 2018)**
13. Discuss HIS color model in details. **Or** Illustrate how color images are represented using HIS model. **(Understanding) (June 2017)**

UNIT II - IMAGE TRANSFORMS (CO2)

Part-A (2 Marks)

1. **What is Image Transform?(Remembering)**
   An image can be expanded in terms of a discrete set of basis arrays called bas images. These basis images can be generated by unitary matrices. Alternatively, a giv(NxN image can be viewed as an N/\2xl vectors. An image transform provides a set I coordinates or basis vectors for vector space.
2. **State the need for transform. (Understanding) (May 2019)**
   The need for transform is most of the signals or images are time domain signal (i.e) signal 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.
3. **What are the applications of an image transform. (Remembering)**
   1) To reduce band width 2) To reduce redundancy 3) To extract feature.
4. **Give the Conditions for perfect transform? (Understanding)**
   1) Transpose of matrix = Inverse of a matrix. 2) Orthoganality.
5. **What are the properties of unitary transform(Remembering)**
   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.
6. **Define fourier transform pair?(Remembering)**
   The fourier transform of f(x) denoted by F(u) is defined by

$$F(u) = \int_{-\alpha}^{\alpha} f(x) e^{-j2\pi ux}\, dx$$

   The inverse fourier transform of f(x) is defined by

$f(x) = \int_{-\alpha}^{\alpha} F(u) e^{j2\pi ux}\, dx$.The equations (1) and (2) are known as fourier transform pair.

7. **Define fourier spectrum and spectral density?(Remembering)**
   Fourier spectrum is defined as
   $F(u) = |F(u)| e^{j\psi(u)}$ Where $|F(u)| = R^2(u)+I^2(u)$, and $\psi(u) = \tan^{-1}(I(u)/R(u))$
   Spectral density is defined by $p(u) = |F(u)|^2$, $p(u) = R^2(u)+I^2(u)$.
8. **Give the relation for I-D discrete fourier transform pair?(Understanding)**
   The discrete fourier transform is defined by

$$F(u) = \frac{1}{N} \sum_{x=0}^{n-1} f(x) e^{-\frac{j2\pi ux}{N}}$$

   The inverse discrete fourier transform is given by

$$f(x) = \frac{1}{N} \sum_{x=0}^{n-1} F(U) e^{\frac{j2\pi ux}{N}}$$

   These equations are known as discrete fourier transform pair.
9. **Specify the properties of 2D Fourier transform. (Remembering)**
   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
10. **Mention the separability property of 2D fourier transform. (Remembering)**
    The advantage of separable property is that F(u, v) and f(x, y) can be obtained by successive application of I D fourier transform or its inverse.

$$f(u,v) = N \frac{1}{N} \sum_{x=0}^{n-1} F(x,y) e^{-\frac{j2\pi ux}{N}}$$

    Where

$$F(x,v) = N \frac{1}{N} \sum_{x=0}^{n-1} f(x,y) e^{-\frac{j2\pi vy}{N}}$$

11. **Write the properties of twiddle factor.(Remembering)**
    1. Periodicity $W_N^{(K+N)} = W_N^K$
    2. Symmetry $W_N^{(K+N/2)} = - W_N^K$
12. **Give the Properties of one-dimensional DFT.(Understanding)**
    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.

13. Give the Properties of two-dimensional DFT.(Remembering) (June 2018)

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

14. What is meant by convolution?(Remembering)

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

15. State convolution theorem for1ID.(Remembering)

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)⇔x) F(u)* G(u) These 2 results are referred to the convolution theorem.

16. What is wrap around error?(Remembering)

The individual periods of the convolution will overlap and referred to as wrap around error.

17. Give the formula for correlation of 1D continuous function.(Remembering)

The correlation of 2 continuous functions f(x) and g(x) is defined by f(x) o g(x) = f*(α) g(x+α) dα

18. What are the Properties of Slant transform?(Remembering)

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 sequence ordered.

19. Specify the properties of forward transformation kernel?(Remembering)

The forward transformation kernel is said to be separable if g(x, y, u, v)

g(x, y, u, v) = gl(x, u).g2(y, v) . The forward transformation kernel is symmetric if gl is functionally equal to g2 g(x, y, u, v) = gl(x, u). gl(y,v).

20. Define Walsh transform.(Remembering)

The Walsh transform is defined by

$$w\ u\ = \frac{1}{N} \sum_{x=0}^{N-1} f\ x\ \prod_{i=0}^{x-1} (-1)^{bi\ x\ .bn-1-i(u)}$$

21. Give the relation for I-D DCT.(Understanding)

The I-D DCT is,

$C\ u\ = \alpha\ u\ \ \sum_{X=0}^{N-1} f\ x\ \cos\ \frac{2x+1\ u\pi}{2N}$ where u= 0, 1,2,.. ..N-l

Inverse

$f\ x\ = \sum_{V=0}^{N-1} \alpha\ u\ c\ u\ \cos\ \frac{2x+1\ u\pi}{2N}$ where x=0,1,2,...N-1

22. Write slant transform matrix SN.(Remembering)

$$SN = 1/\sqrt{2} \begin{pmatrix} 1 & 0 & 0 & 1 & 0 & 0 \\ aN & bN & & -aN & bN & \\ 0 & & I(N/2-1) & 0 & & I(N/2-1) \\ 1 & 0 & 0 & 0 & -1 & 0 \\ -bN & aN & & bN & aN & \\ 0 & & I(N/2-1) & 0 & & -I(N/2-1) \end{pmatrix} S \begin{pmatrix} 0 & \\ N/2 & \\ & \\ 0 & S \\ & N/2 \end{pmatrix}$$

23. Write the Hadamard matrix for N=2. (Understanding)

$$\mathbf{H_2} = \begin{pmatrix} \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \mathbf{-1} \end{pmatrix}$$

24. What is bit plane? (Remembering)

Instead of highlighting gray level images, 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 the image is composed of 8, 1-bit planes ranging from bit plane1-0 (**LSB**) to bit plane 7 (**MSB**).

25. Write the kernel for 2D-DCT and how this lead to data compression. (Remembering)(June 2017)

The 2-D DCT is,

$C\ u\ = \alpha\ u\ \ \sum_{X=0}^{N-1} f\ x\ \cos\ \frac{2x+1\ u\pi}{2N}$ where u= 0, 1,2,.. ..N-l

Inverse

$f\ x\ =\ \sum_{V=0}^{N-1} \alpha\ u\ c\ u\ \cos\ \frac{2x+1\ u\pi}{2N}$ where x=0,1,2,...N-1

- High compaction efficiency for correlated data
- Orthogonal and separable
- Fast, approximate DCT algorithms available due to this DCT is preferred in data compression.

26. List the properties of Haar transform. (Remembering)

- Real and orthogonal
- Very fast transform
- Poor energy compaction for images

27. Differentiate between Fourier transform and wavelet Transform.(Remembering)

S.No	Fourier transform	wavelet Transform
1.	The mathematical expression for Fourier transform is $X\ f\ = \int_{-\infty}^{\infty} x\ t\ .e^{-i\omega t}.dt$ Where the x(t) is Time domain signal and X(f) is the frequency domain signal.	The mathematical expression for wavelet transform is $W_c f\ s,\Gamma\ = \int_{-\infty}^{\infty} x\ t\ .s^{-1/2}\psi\ \frac{\tau-\Gamma}{s}\ .dt$ Where s is scale and Tao is Translation parameter x(t) is original signal.
2.	Suitable for stationary signal.	Suitable for stationary signal and non-stationary signal
3.	Fourier Transform convert signal from time domain to frequency domain signal it provide two dimensional information about any signal that what different frequency component present in a signal and what are their respective amplitudes	wavelet transform gives a complete three dimensional information about any signal i.e. what different frequency components are present in any signal and what are their respective amplitudes and at time axis where these different frequency components exists.
4.	Fourier Transform has zero time resolution and very high frequency resolution	wavelet transform has high time resolution and high frequency resolution as well as time and frequency resolution can also changed
5.	Fourier analysis signal is converted into sin and cosine waves of different amplitudes and frequencies	wavelet transform signal is converted into scaled and translated version of mother wavelet.
6.	Fourier Transform is not suitable for studying the local behavior of signal.	wavelet transform is very suitable for studying the local behavior of the signal for example discontinuity or spikes.
7.	Fourier Transform the input can be a real or complex function but its output is always complex	wavelet transform the input can be a real or complex function but its output may be real or complex
8.	Fourier analysis the signal is converted into sine and cosine waves of various amplitude and frequencies the shapes of sine and cosine wave are well defined , regular and smooth and can be predicted	wavelet transform analysis the signal is converted into scaled and translated version of mother wavelet which is very irregular and cannot be predicted. So, mother wavelet are more suitable for predicting the local behavior of the signal such as irregularities and spikes.

28. Compare Haar and Daubechies wavelet.(Understanding) (June 2017)

Haar wavelet:

- The Haar wavelet is the first and simplest orthonormal wavelet basis.
- The Haar wavelet is conceptually simple, memory efficient, exactly reversible without the edge effects characteristic of other wavelets and computationally cheap.

Daubechies wavelet:

- Daubechies wavelet family is the most popular wavelet family used for texture feature analysis, due to orthogonal and compact support abilities.
- The Daubechies wavelet uses overlapping windows, so the results reflect all changes between pixel intensities. Since Daubechies averages over more pixels, it is smoother than the Haar wavelet.

29. Justify that KLT is an optimum transform. (Understanding) (June 2018)

- It is a representation of a stochastic process as an infinite linear combination of orthogonal functions, analogous to a Fourier series representation of a function on a bounded interval. The transformation is also known as Hotelling transform and eigenvector transform, and is closely related to principal component analysis (PCA) technique widely used in image processing and in data analysis in many fields.
- The importance of the Karhunen–Loève theorem is that it yields the best such basis in the sense that it minimizes the total mean squared error.

30. Write the equation of 2C DCT pair. (Remembering) (May 2019)

$$X_C(k_1, k_2) = \sum_{n_1=0}^{N_1-1} \sum_{n_2=0}^{N_2-1} 4x(n_1, n_2) \cos\frac{\pi k_1}{2N_1}(n_1+1) \cos\frac{\pi k_2}{2N_2}(n_2+1),$$

For $k_1 = 0, 1, \ldots, N_1-1$ and $k_2 = 0, 1, \ldots, N_2-1$, Otherwise, $X_C(k_1, k_2) = 0$.

Part-B (12 Marks questions)

1. Describe in detail the properties of 2D Discrete Fourier transform and its application in Image Processing. **(Remembering)**
2. Check whether the DFT matrix is unitary or not? **(Analyzing)(June 2017)**
3. Compute 2D DFT for the following 3X3 image using separability property and FFT algorithm.

$$x(m,n) = \begin{matrix} 2 & 4 & 2 \\ 2 & 6 & 1 \\ 3 & 4 & 7 \end{matrix}$$ **(Analyzing)**

4. Define 2D DFT. Show that the 2D DFT can be evaluated using an FFT algorithm. **(Understanding)**
5. State and prove convolution property of DFT. **(Remembering) (June 2017)**
6. Compute the discrete cosine transform matrix for N=4. **(Analyzing) (June 2017)**
7. Find DCT transform and its inverse for the given 2*2 image [3 6; 6 4] **(Applying)**
8. Explain the following 2D transforms with properties.**(Understanding)**
   1. DCT 2. DST 3. Walsh Transforms
9. Classify the transforms in Digital Image Processing and explain about the DWT and its wavelets. **(Understanding) (June 2018)**
10. Sketch the basis function of Walsh Transform for N=4. **(Remembering)**
11. Explain about Hadamard transform. **(Understanding) (June 2018)**
12. Using the recursive approach, generate the Hadamard matrix HN for N=8. **(Remembering)**
13. What is Hadamard transform and generate the Hadamard transform matrix for n=3 from its core matrix? **(Understanding)**
14. Define the NxN Slant transform matrix and the various parameters. Obtain the Slant matrix for N=4. **(Remembering)**
15. Derive Haar Kernel for N = 8. **(Understanding) (May 2019)**
16. Give in detail about the following**. (Understanding) (June 2019)**
    (i) Haar wavelet
    (ii) Daubechies wavelet
17. Give in detail about the following**. (Understanding)**
    (iii) Hermitian wavelet
    (iv) Poisson wavelet

UNIT-III - IMAGE ENHANCEMENT AND RESTORATION TECHNIQUES (CO3)

Part-A (2 Marks)

1. **Specify the objective of image enhancement technique.(Understanding)**
   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 two categories of image enhancement. (Remembering)**
   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? (Remembering)**
   Contrast stretching reduces an image of higher contrast than the original by darkenin the levels below m and brightening the levels above m in the image.

4. **What is grey level slicing?(Remembering)**
   Highlighting a specific range of grey levels in an image often is desired. Application includes enhancing features such as masses of water in satellite imagery and enhancer flaws in x-ray images.
5. **Define image subtraction.(Understanding)**
   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?(Remembering)**
   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. **What is meant by masking?(Understanding)**
   Mask is the small 2-D array in which the values of mask co-efficient determine the nature of process. The enhancement technique based on this type of approach is referred to as mask processing.
8. **What is meant by bit plane slicing?(Understanding)**
   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 I-bit planes, ranging from bit plane 0 for LSB to bit plane-7 for MSB.
9. **Define histogram.(Remembering)**
   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.
10. **What is meant by histogram equalization?(Understanding)**

$$Sk = T\ rk\ = \sum_{j=0}^{k} \Pr\ rj\ = \sum_{j=0}^{k} \frac{nj}{n} \quad where\ k = 0,1,2 \ldots \ldots . . L-1$$

    This transformation is called histogram equalization.
11. **What is meant by laplacian filter?(Understanding)**
    The laplacian *for* a function f(x,y) *of* 2 variables is defined as,

$$\nabla f = \partial f / \partial x + \partial f / \partial y$$

12. **Write the steps involved in frequency domain filtering.(Remembering)**
    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). **6**. Multiply the result in (5) by (-1)
13. **Give the formula for transform function of a Butterworth low pass filter. (Remembering)**
    The transfer function of a Butterworth low pass filter of order n and with cut off frequency at a distance D*0* from the origin is, $H(u,v) = 1\ I\ 1 + [\ D(u,v)\ /\ D0]^{2n}$
    Where $D(u,v) = [(u - M/2)^2 + (v-N/2)^2\ ]^{1/2}$
14. **What do you mean by Point processing?(Remembering)**
    Image enhancement at any Point in an image depends only on the gray level at that point is often referred to as Point processing.
15. **Give the mask used for high boost filtering.(Remembering)**

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

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

16. **What is Image Negatives?(Remembering)**
    The negative *of* an image with gray levels in the range *[0,* L-l] is obtained by using the negative transformation, which is given by the expression.
    Negative: S=L-l-r , Log: S = c log (1 +r), Where **c** is constant and r ≥ O
    Where s is output pixel and r is input pixel
17. **Define Derivative filter and name the different types of derivative filters.(Understanding)**
    For a function f (x, y), the gradient f at co-ordinate (x, y) is defined as the vector

$$\triangle F = \begin{bmatrix} \partial f\, l\, \partial x \\ \partial f\, l\, \partial x \end{bmatrix}$$

$\triangle f = mag(\triangle f) = \{[(\partial f / \partial x)^2 + (\partial f / \partial y)^2]\}^{1/2}$

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

18. What is spatial filtering and how it is work?(Remembering)

Spatial filtering is the process of moving the filter mask from point to point in 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

19. What is a Median filter?(Understanding)

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

20. What is maximum filter and minimum filter?(Understanding)

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.

21. Write the application of sharpening filters?(Understanding)

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

22. What is meant by Image Restoration?(Remembering)

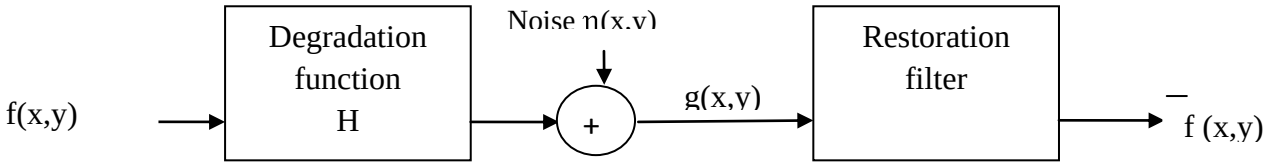
Restoration attempts to reconstruct or recover an image that has been degraded using a clear knowledge of the degrading phenomenon.

23. What are the two properties in Linear Operator and explain?(Remembering)

1. Additivity : $H[f_1(x,y)+f_2(x,y)] = H[f_1(x,y)] + H[f_2(x,y)]$ 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.

2. Homogenity : $H[k_1 f_1(x,y)] = k_1 H[f_1(x,y)]$ 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.

24. Draw image degradation model.(Remembering) (June 2017)



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

$$g(x,y) = F(x,y) + \eta(x,y)$$

25. Give the relation for degradation model for continuous function?(Remembering)

$$g(x,y) = \int_{-\infty}^{\infty} f(\alpha,\beta)\, \delta(x-\alpha, y-\beta)\, d\alpha d\beta + \eta(x,y)$$

26. What is fredholm integral of first kind?(Remembering)

$$g(x,y) = \int_{\infty}^{\infty} f(\alpha,\beta)\, h(x,\alpha,y,\beta)\, d\alpha\, d\beta$$

This 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(a,p) can be calculated by means of fredholm integral.

27. Define circulant matrix?(Remembering)

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.

Example **:**

$$He = \begin{pmatrix} he(0)\ he(M-1)\ he(M-2)\ldots\ldots\ldots\ldots\ldots\ldots he(1) \\ he(1)\ he(0)\ he(M-1)\ldots\ldots\ldots\ldots\ldots\ldots he(2) \\ . \\ . \\ he(M-1)\ he(M-2)\ he(M-3)\ldots\ldots\ldots\ldots\ldots he(0) \end{pmatrix}$$

28. What is concept algebraic approach and what are the two methods of algebraic approach? (Understanding)

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

1. Unconstraint restoration approach 2. Constraint restoration approach

29. Define Gray-level interpolation?(Understanding)

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

30. What is meant by Noise probability density function?(Remembering)

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

31. Why the restoration is called as unconstrained restoration?(Understanding)

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.

32. Differentiate between constrained & unconstrained restoration methods. (Understanding)

The constrained restoration is used when the degradation function is known. The mean and variance of the noise parameters can be calculated from the degradated image.In the absence of any knowledge about the noise unconstrained restoration used.

33. Which is the most frequent method to overcome the difficulty to formulate the spatial relocation of pixels?(Understanding)

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.

34. What are the three methods of estimating the degradation function?(Remembering)

1. Observation 2. Experimentation 3.Mathematical modeling.

35. What are the types of noise models?(Remembering)

1. Guassian noise
2. Rayleigh noise
3. Erlang noise
4. Uniform noise
5. Impulse noise

36. Give the relation for Gaussian noise? (Remembering)

Guassian noise:

The PDF guassian random variable Z is given by $\frac{P\ Z = e^{-\ Z-\mu\ 2\sigma^2}}{\overline{2\pi\sigma}}$

Where Z->Gray level value, σ ->standard deviation,σ^2 ->varianze of Z,
μ->mean of *the* graylevel value Z.

37. Give the relation for Rayleigh noise?(Understanding)

Rayleigh noise: The PDF is

$$P\ Z\ = \begin{matrix} 2\ z-a\ e^{-(z-a)^{\frac{2}{b}}} & for\ Z \geq 0 \\ 0 & for\ Z < 0 \end{matrix}$$

Mean μ= a+ $\overline{\pi b\ /4}$

standard deviation σ^2=b(4-π)/4

38. Give the relation for Gamma noise?(Understanding)

Gamma noise: The PDF is

$$P\ Z\ = \begin{matrix} \frac{a^b z^{b-1} a e^{-az}}{b} & for\ Z \geq 0 \\ 0 & for\ Z < 0 \end{matrix}$$

Mean μ=b/a

standard deviation $\sigma^2=b/a^2$

39. Give the relation for Exponential noise?(Understanding)

Exponential noise : The PDF is

$$P\ Z\ = \begin{matrix} ae^{-az} & for\ Z \geq 0 \\ 0 & for\ Z < 0 \end{matrix}$$

Mean μ=1/a

standard deviation $\sigma^2=1/a^2$

40. Give the relation for Uniform noise?(Understanding)

The PDF is

$$P(Z) = \begin{cases} \frac{1}{b-a} & for\ a \le Z \le 0 \\ 0 & otherwise \end{cases}$$

Mean μ a+b/2

Standard deviation $\sigma^2=(b-a)^2/12$

41. Give the relation for Impulse noise?(Understanding)

Impulse noise: The PDF is

P(Z) = P a for z=0
Pb for z=b
0 Otherwise

42. What is inverse filtering?(Remembering)

The simplest approach to restoration is direct inverse filtering, an estimate F^(u,v) of the for z=a for z=b. Otherwise, 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)

43. What is meant by least mean square filter?(Remembering)

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.

44. Give the difference between Enhancement and Restoration?(Understanding)

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 deblurring function is considered as restoration technique.

45. State how contrast adjustment made in an image. (Understanding)

Image enhancement techniques are used to improve an image, where it is sometimes defined objectively and sometimes subjectively .The contrast adjustment made using histogram function Intensity adjustment in an image enhancement technique that maps an image's intensity values to a new range.

46. Write the toeplitz matrix?(Remembering)

$$t_0 \begin{pmatrix} t_{-1} & \cdots\cdots\cdots & t_{-N+1} & \\ t_1 & t_0 & \cdots\cdots\cdots & t_{-N+2} \\ . & & & \\ t_{N-1} \cdots\cdots & t_2 & t_1 & t_0 \end{pmatrix}$$

47. Mention the drawbacks of inverse filtering. (Understanding) (June 2017)

- It cannot be defined in frequency regions(ù1,ù2) whereÇ(ù1,ù2) is zero
- The inverse filter is very sensitive to noise presence

48. Define and give the transfer function of contra harmonic filter. (Remembering)

The contra-harmonic mean filter is member of a set of nonlinear mean filters which are better at removing Gaussian type noise and preserving edge features than the arithmetic mean filter. The contra-harmonic filter is very good at removing positive outliers for negative values of P and negative outliers for positive values of P.

$$Contra-HarmonicMean(A) = \frac{\sum_{(i,j)\in M} A(x+i,y+j)^{P+1}}{\sum_{(i,j)\in M} A(x+i,y+j)^{P}}$$

49. Define rubber sheet transformation. (Understanding)

Rubber Sheeting is a technique for edge matching and is another name for warping .The process of stretching or transforming the geometric properties of a raster base map for the purpose of aligning the map relative to the surface of the earth that it depicts.

50. What are the possible ways of adding noise in images? (Understanding)

- Image acquisition system like Cameras and Sensors
- Pseudo random noise
- Temperature

51. How image averaging is done?(Understanding)

Image averaging is done by computing an average or arithmetic mean of the intensity values for each pixel position in a set of captured images from the same scene. In the averaging process, the signal component of the image remains the same, but the noise component differs from one image

frame to another. Because the noise is random, it tends to cancel during the summation. When the averaged image is computed, the image signal component has a stronger influence over the summation than does the noise component.

52. Give any two applications of Hough transform. (Understanding)

1. Road/Sign detection in intelligent driving system
2. Pupil detection in iris recognition detection

53. Compare spatial and frequency domain methods. (Understanding) (June 2018)

Spatial domain	Frequency domain
It deals with image plane itself.	It deals with the rate of pixel change.
It works based on direct manipulation of pixels.	It works based on modifying fourier transform
It takes less time to compute	It takes more time to compute.

54. Construct the image observation model. (Understanding) (June 2018)

55. If all pixels in an image are shuffled, will there be any change in histogram? Justify your answer. (Understanding) (May 2019)

Histogram of an image also shows the frequency. But an image histogram, shows frequency of pixels intensity values. In an images histogram, the x axis shows the gray level intensities and the y axis shows the frequency of these intensities.

56. Differentiate between image enhancement and image restoration. (Understanding) (May 2019)

Image enhancement	Image restoration
The original image is processed so that the resultant image is more suitable than the original for specific applications.	It is to bring the image towards what it removal of image blur would by applying a deblurrings functions is considered.
It is to improve the image to show some hidden details.	It is to improve the image to match the original image.

Part-B (12 Marks questions)

1. Explain the types of gray level transformation used for image enhancement. **(Remembering)**
2. Explain in detail about Histogram modification and specification techniques in spatial domain. **(Understanding)**
3. Discuss the method for smoothing the image in frequency domain. **(Remembering) (May 2019)**
4. What are image sharpening filters? Explain the various types of it**.(Remembering)**
5. How mean filters are used for image enhancement. **(Remembering)**
6. What is geometric mean and harmonic mean with reference to an image? What purpose do they serve for images analysis? Discuss. **(Remembering)**
7. With the help of block diagram discuss the principle of homomorphic filtering. **(Understanding)**
8. Describe the procedure for Homomorphic filtering.(Or) Describe how Homomorphic filtering is used to separate illumination and reflectance components.**(Remembering) (June 2017)**
9. Explain color image enhancement in brief. **(Remembering)**
10. Explain image degradation and restoration process in detail**.(Remembering)**
11. Illustrate the different causes of image restoration. **(Remembering)**
12. Describe the constrained least square filtering for image restoration and derive its transfer function. **(Understanding)**
13. Differentiate constrained and unconstrained restoration. **(Understanding) (June 2018)**
14. What is wiener filtering approach? How is it used for image restoration? Describe. **(Remembering) (June 2017)**
15. Derive the wiener filter for image restoration and specify its advantages over inverse filter. **(Applying) (May 2019)**
16. Elucidate on inverse filtering. **(Remembering) (June 2018)**
17. What is histogram equalization? Analyze the procedure involved in histogram matching. **(Analyzing) (June 2018)**

18. Illustrate the steps in histogram equalization of the image and obtain histogram equalization for the following image segmentation of size 5x5. Write the interference on image segment before and after equalization. **(Applying) (June 2017)**

$$\begin{matrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{matrix}$$

19. A blur filter h(m,n) is given by $\begin{matrix} 0.1 & 0.1 & 0.1 & 0 \\ 0.1 & 0.1 & 0.1 & 0.1 \\ 0.05 & 0.1 & 0.1 & 0.05 \\ 0 & 0.05 & 0.05 & 0 \end{matrix}$. Find the deblur filter using inverse filtering. **(Applying)**

20. Perform histogram equalization for the 4x4 image given below. **(Applying) (May 2019)**

$$x\ m,n\ = \begin{vmatrix} 10 & 12 & 8 & 9 \\ 10 & 12 & 12 & 14 \\ 11 & 13 & 10 & 9 \\ 10 & 14 & 12 & 14 \end{vmatrix}$$

21. Explain the concept of geometric transformation for image restoration.**(Remembering)**

UNIT IV -IMAGE SEGMENTATION AND REPRESENTATION (CO4)

PART-A (2 Marks)

1. **What is segmentation?(Remembering)**
   Segmentation subdivides on image in to it's 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. **Mention the applications of image segmentation. (Remembering)**
   * Detection of isolated points. * Detection of lines and edges in an image.
3. **Classify the types of discontinuity in digital image. (Understanding) (June 2018)**
   Points, lines and edges.
4. **How the derivatives are obtained in edge detection during formulation?(Remembering)**
   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.(Understanding)**
   The approach for linking edge points is to analyze the characteristics of pixels in asmall 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? (Remembering)**
   (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?(Remembering)**
   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.
8. **Give the properties of the second derivative around an edge?(Remembering)**
   - 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.

9. Define Gradient Operator?(Remembering)

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

$$\Delta f = mag\ \Delta f = \overline{[Gx^2 + Gy^2}$$

$\alpha(x,y)=\tan^{-1}(Gy/Gx)$

10. What is meant by object point and background point? (Remembering)

To extract the light objects from the dark background is to select a threshold T that separates 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?(Remembering)

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? Or Give the principle of region growing. (Remembering) (June 2017, May 2019)

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.

13. Specify the steps involved in splitting and merging?(Understanding)

1. Split into 4 disjoint quadrants any region $R_i$for which $P(R_i)$=FALSE.
2. Merge any adjacent regions R_j and $R_k$for which $P(R_jUR_k)$=TRUE.
3. Stop when no further merging or splitting is possible.

14. Define chain codes?(Remembering)

Chain codes are used to represent a boundary by a connected sequence of straight line segment of specified length and direction. This representation is based on 4 or 8 connectivity of the segments.

15. What are the demerits of chain code?(Remembering)

* 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.

16. What is thinning or skeletonizing algorithm?(Remembering)

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 playa 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.

17. Specify the various image representation approaches(Remembering)

1). Chain codes 2). Polygonal approximation
3). Boundary segments 4). Skeletons

18. What is polygonal approximation method?(Remembering)

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.

19. Specify the various polygonal approximation methods.(Remembering)

1). Minimum perimeter polygons 3). Splitting techniques
2). Merging techniques

20. What is the condition for point detection?(Remembering)

Point detected at the location on which the mask is centered if $|R| \geq T$

T = threshold,

$$R = \sum_{i=1}^{9} \omega_i z_i$$

z_i= grey level of the pixel associated with mask coefficients ω_i.

21. What is edge detection and How edges are detected?(Remembering)

It is for detecting meaningful discontinues in the gray level. First and second order digital derivatives are used for detection of edges in an image.

22. What is the need for edge linking?(Remembering)

Due to noise, non uniform illumination, the pixels do not form a binary. So edge linking is required to assemble edge pixels in to meaningful edges.

23. Give the masks used for detecting lines in various detection? (Remembering)

Horizontal 1, vertical and 145^o slanting lines.

Horizontal

-1	-1	-1
2	2	2
-1	-1	-1

+45

-1	-1	2
-1	2	-1
2	-1	-1

Vertical

-1	2	-1
-1	2	-1
-1	2	-1

-45

2	-1	-1
-1	2	-1
-1	-1	2

24. What is the role of gradient operator and Lapkuan operator in segmentation? (Remembering)

Gradient operator is used to derivative with in use to detect the presence of an edge in the image. Laplacian operator in for second derivatives and its sign is used to determine whether the edge pixel line on the dark side (or) light side of an edge.

25. Mention the properties that linked the pixels in local processing.(Understanding)

1. The strength of the greelient operator response to produce the edge pixel

$$\Delta f = mag\ \Delta f\ = \overline{[Gx^2 + Gy^2}$$

2. The direction of the gradient.

26. Write down the steps involved in edge linking by global processing via Hough transform. (Understanding)

1. Compute the gradient of an image and threshold if to obtain a binary image.
2. Specify subdivisions in the pθ-plane.
3. Examine the relationship between pinels in a chosen cell.

27. What is Thresholding?(Remembering)

Thersholder range g(x,y) is defined as

$$g\ x,y\ = \begin{matrix} 1 & if & f\ x,y\ > T \\ 0 & if & f(x,y) \leq T \end{matrix}$$

28. What is Quad tree?(Remembering)

A tree in which each made has exactly 4 descendents.

29. What is the aim of polygonal approximation?(Remembering)

To capture the essence of the boundary shape with the fewest possible polygonal segments.

30. What is merging techniques in polygonal approximation?(Remembering)

It is based on average error. Merge the points along a boundary until the least square error line fit of the points merged.

Disadvantage: vertices do not always correspond to inflections in the original boundary.

31. What is splitting techniques in polygonal approximation?(Remembering)

This technique is to subdivide a segment successively into two parts until a specified criterion is satisfied.

32. What is meant by Signatures?(Remembering)

It is a ID functional representation of a boundary. To generate signature plot the distance from the centroid to the boundary as a function of angle.

33. What is meant by skeletons?(Remembering)

It is the representation of the structural shape of a plane region is reducing it to a graph. Thus reduction is obtained by skeleton of the region via a thinning algorithm.

34. Write the importance of edge detection.(Understanding)

The importance of edge detection is to identifying the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.

35. What is Lagrange multiplier? Where it is used?(Remembering)

Lagrange multipliers used to be viewed as auxiliary variables introduced in a problem of constrained minimization in order to write first-order optimality conditions formally as a system of equations. This is used for image restoration to identify and calculating the noise functions in constrained image restoration method.

36. Why blur is to be removed from images? (Remembering)

The blurring causes reduction in the edges and sharpness of picture in both foreground and background of the images. This will reduce the quality of the images and if made any analysis based upon this image lead misinterpretation of the data. In order to overcome this blur must be removed from the images.

37. State the problems in region splitting and merging based image segmentation. (Understanding)

- Algorithms are usually less complex: they tend to use local properties and software and hardware implementations are readily available.
- Humans may use edge detection: there is evidence of links between edge detection and early human visual processing, which lead to the observation that contoured images are more easily identified than regional images, particularly when degraded in some form.
- Edges are often more useful in matching: as finding regions or edges is often preliminary to identifying objects, it is important that edges have an easier model description (as lines).

38. Compare region splitting and merging in image compression. (Remembering)

region splitting	region merging
This splitting procedure is repeated recursively until we split the image into homogeneous regions	If a region R is inhomogeneous (P(R)= False) then is split into four sub regions
It produces an image representation that can be described by a tree whose nodes have four sons each Such a tree is called a Quad tree	The algorithm stops when no further splitting or merging is possible
Splitting techniques disadvantage are they create regions that may be adjacent and homogeneous, but not merged.	The split and merge algorithm produces more compact regions than the pure splitting algorithm

39. How the boundary of an image is represented using chain code?(Remembering)

To represent a boundary by a connected sequence ofstraight line segments of specified length and direction. The direction of each segment is coded by using anumbering scheme such as the ones shown below.

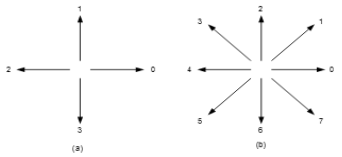


Fig 1. Directions for (a) 4-directional chain code and (b) 8-direction chain code.

This method generally is unacceptable to apply for the chain codes to pixels:

a. The resulting chain of codes usually is quite long.
b. Sensitive to noise: any small disturbances along the boundary owing to noise or imperfect segmentation cause changes in the code that may not necessarily be related to the shape of the boundary.

A frequently used method to solve the problem is tore sample the boundary by selecting a larger grid spacing.

40. Write sobel horizontal and vertical edge detection mask. (Remembering) (June 2017)

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

Horizontal mask

1	0	1
-2	0	2
-1	0	1

Vertical mask

42. List the approaches to describe texture of a region. (Understanding) (June 2018)

Statistical approach – pixel intensity distribution

Structured approach – set of texels in some regular or repeated pattern.

43. Sketch the three types of edges. (Remembering) (May 2019)

PART-B (12 Marks)

1. What is image segmentation? Explain in detail.**(Remembering)**
2. How is line detected? Explain through the operators. **(Understanding)**
3. Describe gradient operation based edge detection method and explain**.(Understanding) (June 2017)**
4. Explain in detail about the line, point and edge detection methods.**(Understanding)**
5. Explain in detail about edge linking via Hough transform. **(Understanding) (May 2019) or** How Hough transform is used in global processing? **(Remembering) (June 2018)**
6. Describe in detail about the morphological operations. **(Remembering) or** What do you understand by dilation and erosion in morphological operation? Discuss in detail. **(Understanding) (June 2018)**
7. Define Thresholding and explain the various methods of thresholding in detail. **(Understanding) or** Explain image segmentation based on thresholding concept. **(Understanding) (June 2017)**
8. Distinguish between local and global thresholding techniques for image segmentation. **(Understanding)**
9. Explain the segmentation techniques that are based on finding the regions directly**. (Understanding) or** Discuss in detail about region based segmentation techniques**. (Understanding) (May 2019)**
10. What is meant by region based segmentation and region growing and explain with an example. **(Understanding) (June 2018)**
11. Explain region splitting and merging for image segmentation**.(Understanding) (June 2017)**
12. Discuss chain code & signature in image representation with suitable examples**. (Understanding) (June 2017, May 2019)**
13. Discuss in detail about boundary segments and skeletons in image representation. **(Understanding)**
14. Explain the boundary descriptors in image representation. **(Understanding) (June 2018)**
15. Discuss the principle of image segmentation by watershed transformation and explain its drawbacks. **(Understanding)**

UNIT V - IMAGE COMPRESSION

Part-A (2 Marks)

1. **What is image compression? (Remembering)**
   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?(Remembering)**
   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?(Remembering)**
   - 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 digitized voice where losses outside visual or aural perception can be tolerated.
4. **What is the need for data Compression?(Remembering) (June 2017,May 2019)**
   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. 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?(Remembering)**
   Run Length Encoding (RLE), Arithmetic coding Huffman coding and Transform coding.
6. **What is run length coding?(Remembering)**
   Run-length coding, 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.
7. **Define compression ratio.(Remembering)**
   Compression **Ratio** = original size / compressed size: 1
8. **What are the operations performed by error free compression?(Remembering)**
   1) Devising an alternative representation of the image in which its interpixel redundant are reduced.
   2) Coding the representation to eliminate coding redundancy
9. **What is Variable Length Coding?(Remembering)**
   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.
10. **Define Huffman coding.(Remembering)**
    - Huffman coding is a popular technique for removing coding redundancy.
    - When coding the symbols of information source the Huffman code yields the smallest possible number of code words, code symbols per source symbol.
11. **Define Block code.(Remembering)**
    Each source symbol is mapped into fixed sequence of code symbols or code words. So it is called as block code.
12. **Define compression ratio.(Remembering)**
    Compression **Ratio** = original size / compressed size: 1
13. **What are the operations performed by error free compression?(Remembering)**
    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?(Remembering)**
    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.(Remembering)

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

16. Define Block code.(Remembering)

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

17. Define instantaneous code.(Remembering)

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

18. Define uniquely decodable code.(Remembering)

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

19. Define B2 code.(Remembering)

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

20. Define the procedure for Huffman shift.(Remembering)

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.

21. Define arithmetic coding.(Remembering)

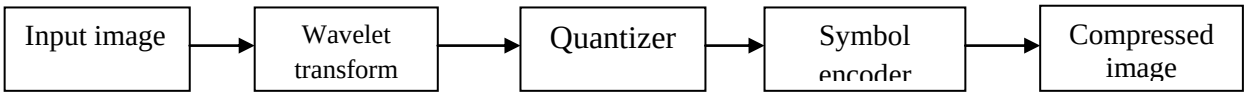
In arithmetic coding one to one corresponds between source symbols and code word doesn't exist where as the single arithmetic code word assigned for a sequence of source symbols. A code word defines an interval of number between 0 and 1.

22. What is bit plane coding?(Remembering)

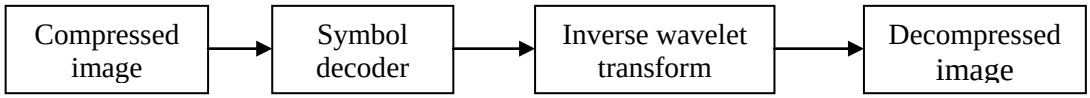
An effective technique for reducing an image's inters pixel redundancies is to process the image's bit plane individually. This technique is based on the concept of decomposing multilevel images into a series of binary images and compressing each binary image via one of several well-known binary compression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

23. Draw the block diagram of transform coding system.(Remembering)

Encoder



Decoder



24. What is relative address coding?(Remembering)

It is based on the principle of tracking binary transitions that being and end each block and white run.

25. What are three categories of constant area coding?(Remembering)

The three categories of constant area coding are 1. All white 2. All black 3. 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 '

26. Define P-frame.(Remembering)

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

27. Define B-frame.(Remembering)

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.

28. What is LZW code?(Remembering)

If assign fixed length code words to variable length sequence of sources symbols bit requires no a priori knowledge of the probability of occurrence of the symbols to be encoded.

29. What is the feature of LZW code?(Remembering) Code book is created while the data are being encoded LZW decoder builds an identical decompression code book as it decodes simultaneously the encoded data stream.

30. What is transform coding? (Remembering)

Linear transform is used to map the image into a set of transform coefficient, which are then quantized and coded. (Ex. Zonal coding, Threshold coding).

31. Define I frame?(Remembering)

An I frame is compressed independently of all previous and future video frames. I frame provide the fights degree of random access, ease of editing and greatest resistance to the propagation of transmission error.

32. What is Zonal coding?(Remembering)

In zonal coding, the information is viewed as uncertainty. Therefore the transform coefficients of maximum variance carry the most picture information and should be retained in the coding process. The zonal sampling process can be viewed as multiplying each transform coefficient T (u,v) by the corresponding element in a zonal mask, which is constructed by placing a 1 in the locations of maximum variance and a 0 in all other locations.

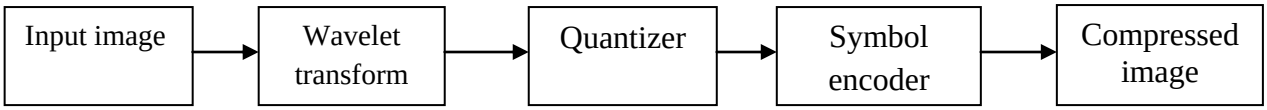
33. What is Threshold coding?(Remembering)

Zonal coding is implemented by using a signal fixed mask for all the sub images. Threshold coding is adaptive in the sense that the location of transform coefficients refrained for each sub image vary from one sub image to another. For any sub image the transform coefficients of largest magnitude make the most significant of largest magnitude make the most significant contribution sub image quality.

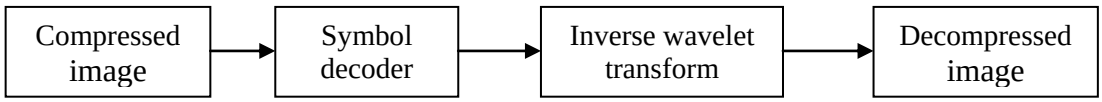
34. What is Wavelet coding?(Remembering)

It is based on the idea that the coefficients of a transform that decorrelater the pixels of an image can be coded more efficiency than the original pixel themselves.

Encoder



Decoder



35. What is difference between transform and wavelet transform?(Remembering)

In wavelet coding there in no transform coder's sub image processing stage. Because wavelet transforms are both compututationally efficient and inherently local.

36. What are standards used for Binary image compression?(Remembering)

(1). CCITT Group 4 and 4 standards. (2). Group 3 standard applies a non adaptive, ID run length coding technique. (3).In group 4 standard, only 2D coding in allowed.

37. What is ID compression in binary image standards?(Remembering)

Each line of an image is encoded as a series of Variable length code words that represent the run lengths of the alternating white and black runs in a left to right scan of the line.

38. What is 2D compression in Binary image compression?(Remembering)

It is line method in which the position of each block to white (or) white to black run transition is coded with respect to the position of the reference element that is situated on the current coding line.

39. What is base line coding system in JPEG.(Remembering)

It is based on the DCT and is adequate for most compression applications.

40. What is extended coding system in JPEG?(Remembering)

It is for greater compression, higher precision or progressive reconstruction applications.

41. What is independent coding system in JPEG?((Remembering)

It is for reversible compression.

42. What is relative data redundancy?(Remembering)

R=1-(1/C) ; C=Compression Efficiency

43. Distinguish between scalar and vector quantization. (Understanding)

Scalar quantization	Vector quantization
In scalar quantization, each sample is quantized independently	In vector quantization, each of the samples is not quantized. Instead, a set of continuous-valued samples, expressed collect lively as a vector is represented by a limited number of vector states.

44. List the performance metrics for image compression.(Understanding) (June 2018)

- Compression factor
- Entropy
- Removal of redundancy

45. In an image compression system, 16384 bits are used to represent a 128X128 image with 256 gray levels. What is the compression ratio for this system? (Understanding)

Number of bits required to store a 256 X 256 image with 256 gray levels is.
256 gray levels = 28 =8 bits
Therefore 128 * 128 * 8 = 131,072 bits
The ratio of the original(uncompressed) image to the compressed image is referred to as the Compression Ratio CR.
CR = Uncompressed image size/Compressed image size
Uncompressed image size for the given data above= 131,072 bits
Compressed image size as given in the question = 16384 bits
Therefore, compression ratio = 131,072 /16384 = 8

46. Choose any two application areas in which error free compression is used. (Remembering)

Documents, text and computer programs

47. Compare Lossy compression and lossless compression. (Understanding) (June 2017, May 2019)

S.No	Lossy Compression	Lossless Compression
1.	The technique involves some loss of information.	Involves no loss of information.
2.	Data that has been compressed using this technique can't be recovered and reconstructed exactly.	If data has been (lossless) compressed, the original data can be recovered from the compressed data.
3.	Used for application that can tolerate difference between the original and reconstructed data.	Used for application that can't tolerate any difference between original and reconstructed data.
4.	In return for accepting this distortion in reconstructed data we obtain high compression rate	No loss in information so compression rate is small.
5.	Sound and Image compression uses lossy compression.	Text compression uses lossless compression
6.	More data can be accommodated in channel.	Less data can be accommodated in channel.
7.	Distortion	Distortion less
8.	E.g.(i)Telephone System,(ii)Video CD	E.g(i)Fax Machine, (ii)Radiological Imaging
9.	Example: Text compression -> It is very important that the reconstruction is identical to original text, as very small difference can result in statements with very different meanings. Consider " Do not send Money " and " Do now send Money "	Example: When viewing a reconstruction of a video sequence, the fact that the reconstruction is different from the original is generally not important as long as the difference do not result in annoying artifacts. Thus, video is generally compressed using lossy compression.

PART-B (12 Marks)

1. Explain the need for data compression and compare lossless and lossy compression. **(Understanding)**
2. What is data redundancy? Explain three basic data redundancy?**(Remembering)**
3. Explain the need for image compression. How run length encoding approach is used for compression? Is it lossy? Justify. **(Analyzing) (June 2018)**

4. Illustrate run length coding and LZW coding with examples. **(Applying) (June 2017, May 2019)**
5. Perform Bit plane coding on the following image. **(Applying)**

$$x\ m,n\ = \begin{matrix} 6 & 6 & 7 \\ 6 & 2 & 7 \\ 3 & 3 & 2 \end{matrix}$$

6. Explain detail about Huffman coding with suitable example. **(Understanding)**
7. For the image shown below compute the compression ration that can be achieved using Huffman coding. **(Applying)**

3	3	3	2
2	3	3	3
3	2	2	2
2	1	1	0

8. Explain in detail about the scalar and vector quantization**.(Understanding) (June 2018)**
9. Elaborate how vector quantization is used for compression. **(Remembering) (June 2017, May 2019)**
10. Discuss in detail about the block truncation coding.**(Remembering)**
11. Describe in detail applications of image processing. **(Understanding)**
12. Describe about Image forensic science. **(Remembering)**

Reg. No. : 1 4 1 5 0 0 6

K.S.R. COLLEGE OF ENGINEERING, TIRUCHENGODE – 637 215

(AUTONOMOUS)

Question Paper Code : 162233

B. E. / B.Tech. DEGREE END SEMESTER EXAMINATION, JUNE 2017

Sixth Semester

B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING

12EC3641 - Digital Image Processing

(Regulations 2012)

Time: Three hours **Maximum Marks: 100**

Answer All Questions

PART A — (10 x 2 = 20 Marks)

1. State mach band effect.
2. Find the number of bits required to store a 256 X 256 image with 8 bit representation.
3. Write the kernel for 2D - DCT and how this lead to data compression.
4. Compare Haar and Daubechies wavelet.
5. Draw image degradation model.
6. Mention the drawback of inverse filtering.
7. Give the principle of region growing.
8. Write sobel horizontal and vertical edge detection mask.
9. State the need for data compression.
10. Compare lossy compression and lossless compression.

PART B — (5 x 16 = 80 Marks)

11. (a) (i) Explain the basic concept of image sampling and quantization with neat sketch (8)

(ii) Briefly discuss about elements of Digital Image Processing System (8)

(Or)

(b) (i) Discuss HSI color model in detail (8)

(ii) Explain relation between pixels. (8)

12. (a) (i) Check whether the DFT matrix is unitary or not? (8)

(ii) State and prove convolution property of DFT (8)

(Or)

(b) (i) Compute the discrete cosine transform matrix for N = 4. (8)

(ii) Describe various steps involved in the computation of KL Transform with necessary equations. Explain how it is used for data compression? (8)

13. (a) Describe histogram equalization. Obtain histogram equalization for the following image segment of size 5 x 5 Write the inference on image segment before and after equalization. (16)

$$\begin{pmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{pmatrix}$$

(Or)

(b) (i) Describe how homomorphic filtering is used to separate illumination and reflectance components (8)

(ii) What is wiener filtering approach? How is it used for image restoration? Describe. (8)

14. (a) (i) Describe gradient operation based edge detection method and explain. (8)

(ii) Explain region splitting and merging for image segmentation. (8)

(Or)

(b) (i) Explain image segmentation based on thresholding concept. (8)

(ii) Discuss chain codes & signatures in image representation. (8)

15. (a) Analyze about: (16)

(i) LZW coding.

(ii) Run length coding

(Or)

(b) (i) Explain the vector quantization with neat block diagram. (8)

(ii) Write short notes on digital image watermarking. (8)

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Reg. No. : | | | | | | | |

K.S.R. COLLEGE OF ENGINEERING, TIRUCHENGODE – 637 215

(AUTONOMOUS)

Question Paper Code : 172260

B. E. / B.Tech. DEGREE END SEMESTER EXAMINATION, JUNE 2018

Sixth Semester

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

12EC3641 – Digital Image Processing

(Regulations 2012)

Time: Three hours **Maximum Marks: 100**

Answer All Questions

PART A — (10 x 2 = 20 Marks)

1. Define optical illusion and mach band.
2. What is meant by dither?
3. Identify the properties of 2D Fourier transform.
4. Justify that KLT is an optimum transform.
5. Compare spatial and frequency domain methods.
6. Construct the image observation model.
7. Classify the types of discontinuity in digital image.
8. List the approaches to describe texture of a region.
9. List the performance metrics for image compression.
10. Choose any two application areas in which error free compression is used.

PART B — (5 x 16 = 80 Marks)

11. (a) (i) What are the elements of image processing system? Describe it's function. (10)

(ii) Explain any four basic relationships between pixels. (6)

(Or)

(b) Demonstrate the use of RGB colour model and its conversion from one to another. (16)

12. (a) Classify the transforms in Digital Image Processing and explain about the DWT and its wavelets. (16)

(Or)

(b) (i) Explain about Hadamard transform. (8)

(ii) Explain about Karhunen - Loeve transform. (8)

13. (a) What is histogram equalization? Analyze the procedure involved in histogram matching. (16)

(Or)

(b) (i) Differentiate constrained and unconstrained restoration. (8)

(ii) Elucidate on inverse filtering. (8)

14. (a) (i) How Hough transform is used in global processing? (10)

(ii) What do you understand by dilation and erosion in morphological operation? Discuss in detail. (6)

(Or)

(b) (i) What is meant by region based segmentation and region growing and explain with an example. (10)

(ii) Explain the boundary descriptors in image representation. (6)

15. (a) Explain the need for image compression. How run length encoding approach is used for compression? Is it lossy? Justify. (16)

(Or)

(b) Discuss about the following

i)Vector quantization. (8)

ii) Scalar quantization. (8)

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Reg. No. : | | | | | | | |

K.S.R. COLLEGE OF ENGINEERING, TIRUCHENGODE – 637 215

(AUTONOMOUS)

B. E. / B.Tech. DEGREE END SEMESTER EXAMINATION, APRIL / MAY - 2019

Sixth Semester

B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING

12EC3641 – Digital Image Processing

(Regulations 2012)

Time: Three hours **Maximum Marks: 100**

Answer ALL Questions

PART A — (10 x 2 = 20 Marks)

1. Define spatial and Gray level resolution.

2. What is Machband effect?

3. State the need for transform.

4. Write the equation of 2D DCT pair.

5. If all pixels in an image are shuffled , will there be any change in histogram? Justify your answer.

6. Differentiate between image enhancement and image restoration.

7. Sketch the three types of edges.

8. Define region growing.

9. State the need for data compression.

10. Distinguish between lossy compression from lossless compression.

PART B — (5 x 16 = 80 Marks)

11. (a) Explain the components of image processing system. (16)

(OR)

(b) (i) Discuss the effects of non uniform sampling and quantization. (8)

(ii) Illustrate how color images are represented using HSI model. (8)

12. (a) Derive Haar Kernel for N = 8. (16)

(OR)

(b) Give in detail about the following.

(i) Haar wavelet (8)

(ii) Daubechies wavelet. (8)

13. (a) (i) Explain histogram equalization using an example. (8)

(ii) Discuss the method for smoothing the image in frequency domain. (8)

(OR)

(b) Derive a wiener filter for image restoration and specify its advantages over inverse filter. (16)

14. (a) Discuss in detail about the following.

(i) Edge linking using Hough transform (8)

(ii) Region based segmentation techniques. (8)

(OR)

(b) Explain chain code and signatures with suitable examples. (16)

15. (a) Illustrate run length coding and LZW coding with examples. (16)

(OR)

(b) (i) Elaborate how vector quantization is used for compression. (10)

(ii) Describe about digital image watermarking. (6)

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