S.A. ENGINEERING COLLEGE, CHENNAI-77.
(An Autonomous Institution, Affiliated to Anna University)
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
QUESTIONBANK

AcademicYear :2025-2026(ODD)
Year/ Sem : III/V
Subject Code : AD1502A
Subject Name : DIGITAL IMAGE PROCESSING
Common to : NONE

UNIT I- DIGITAL IMAGE FUNDAMENTALS

CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

PART- A

Qno	Questions	CO	BT	Competence
1.	Define Digital Image.	CO1	BTL-1	Remember
2.	List the various real-time applications of Digital Image Processing.	CO1	BTL-1	Remember
3.	What is Sampling and Quantization?	CO1	BTL-1	Remember
4.	What is the memory required to store a 512*512 RGB image of 8-bit resolution?	CO1	BTL-2	Understand
5.	Give the formula for calculating D4 (City Block) and D8 (Chess Board) distance.	CO1	BTL-1	Remember
6.	List the hardware oriented color models.	CO1	BTL-1	Remember
7.	What are the neighbors of a pixel?	CO1	BTL-1	Remember
8.	What is Image Transform? And what is the need for transform?	CO1	BTL-1	Remember
9.	Define Intensity (or) gray level.	CO1	BTL-1	Remember
10.	Define MPEG Standard.	CO1	BTL-1	Remember
11.	List the main components of a digital image processing system with the block diagram.	CO1	BTL-1	Remember
12.	Define 4-neighbors and diagonal neighbors of a pixel.	CO1	BTL-1	Remember
13.	Find the number of bits required to store a 256 X 256 image with 32 gray levels.	CO1	BTL-2	Understand
14.	Draw the block diagram for the steps involved in digital Image processing system.	CO1	BTL-1	Remember
15.	Differentiate between luminance and chrominance with examples.	CO1	BTL-2	Understand
16.	Differentiate photopic and scotopic vision.	CO1	BTL-2	Understand

17.	Differentiate brightness and contrast.	CO1	BTL-2	Understand
18.	List any two properties of 2D Fourier Transform.	CO1	BTL-1	Remember
19.	What is meant by mach-band effect?	CO1	BTL-1	Remember
	PART– B& C			
1.	What are the elements (components) of digital image processing system? Explain the function of each element in detail.	CO1	BTL-2	Understand
2.	Explain the fundamental steps in digital Image Processing System.	CO1	BTL-2	Understand
3.	What is a color model? What are its types? Explain RGB and HSI models and its conversion with necessary diagrams.	CO1	BTL-2	Understand
4.	With a neat diagram explain in detail the construction and operation of various image acquisition devices. (or) Explain the principle and working of Vidicon digital camera with neat diagram.	CO1	BTL-2	Understand
5.	What is the need for image compression? Explain image compression standards in detail.	CO1	BTL-2	Understand
6.	With a neat block diagram, illustrate transform based Image compression scheme. Also give two valid reasons for the choice of "Discrete Cosine Transform" in JPEG image compression standard.	CO1	BTL-3	Apply
7.	How an image is quantized? Explain what is the effect on the image quantization levels if it is reduced?	CO1	BTL-2	Understand
8.	Apply 2D DCT for the given 4x4 image f(x,y) = 2 4 4 2 4 6 8 3 2 8 10 4 3 8 6 2	CO1	BTL-3	Apply
9.	Construct Huffman code for the word "ILLUSION". Also compute the efficiency of Huffman code.	CO1	BTL-3	Apply
10.	Encode the word a1 a2 a3 a4 using arithmetic code and generate the tag for the given symbol with probabilities. a1→0.2, a2→0.2, a3→0.4, a4→0.2	CO1	BTL-3	Apply
11.	Explain the concept of Brightness adaptation and discrimination	CO1	BTL-2	Understand
12.	Illustrate the MPEG encoder and decoder with block diagram	CO1	BTL-3	Apply
13.	Illustrate in detail about the discrete cosine transform (DCT) and its properties. Also compare DCT with DFT	CO1	BTL-3	Apply
14.	i) Explain in detail the ways to represent the digital image. ii) Write short notes on: (a) Neighbors of Pixels (b) Distance Measures (c.) Connectivity (d.) Adjacency.	CO1	BTL-2	Understand
15.	Illustrate the Fourier transform and its significance in image	CO1	BTL-3	Apply

	processing?Explain the properties of the 2-D Discrete Fourier Transform.			
16.	Apply the Huffman code assignment procedure on the following data. **SYMBOL PROBABILITY** a1 0.1 a2 0.4 a3 0.06 a4 0.1 a5 0.04 a6 0.3 Compute the average length of the code and the entropy of the source. Is Huffman code uniquely decodable? If so, justify your answer.	CO1	BTL-3	Apply
17.	Apply arithmetic coding for the below problem where a five symbol sequence or message, a3a1a4a2a3 is coded and their probabilities. **Source Symbol** **Probability** a_1 0.2 a_2 0.2 a_3 0.4 a_4 0.2	CO1	BTL-3	Apply
18.	Apply Huffman coding procedure to the following message ensemble and determine average length of encoded message and coding efficiency with a detailed explanation levels(r) W W2 W3 W4 W5 W6. probability p(r) 0.4 0.3 0.2 0.05 0.03 0.02.	CO1	BTL-3	Apply

UNIT II - IMAGE ENHANCEMENT				
CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.				
PART- A				
Qno	**Questions**	**CO**	**BT**	**Competence**
1.	Define Image Enhancement. What are the two categories of Image Enhancement?	CO2	BTL-1	Remember
2.	State the transfer function for Butterworth filter.	CO2	BTL-2	Understand
3.	If all the pixels in an image are shuffled, will there be any change in the histogram? Justify your answer.	CO2	BTL-2	Understand
4.	What would be the effect on the histogram if we set to zero i) higher order bit plane ii) lower order bit plane?	CO2	BTL-2	Understand
5.	Specify the objective of image enhancement technique.	CO2	BTL-1	Remember
6.	Define Median Filtering.	CO2	BTL-1	Remember
7.	Define Mask and what is meant by spatial mask.	CO2	BTL-1	Remember
8.	Why smoothing linear filters also called as averaging filters?	CO2	BTL-2	Understand
9.	For an 8-bit image, write the expression for obtaining the negative of the input image.	CO2	BTL-1	Remember
10.	What do you mean by contrast stretching?	CO2	BTL-1	Remember
11.	Mention the various image enhancement techniques.	CO2	BTL-1	Remember
12.	Discuss the advantage & disadvantages of piece-wise Linear Transformations.	CO2	BTL-2	Understand
13.	List the types of gray level transformation functions used in Image Enhancement.	CO2	BTL-1	Remember
14.	Give the expression for power-Law Transformations.	CO2	BTL-1	Remember
15.	What is meant by Bit-plane slicing?	CO2	BTL-1	Remember
16.	What is meant by histogram specification?	CO2	BTL-1	Remember
17.	What is Log Transformations and give the expression?	CO2	BTL-1	Remember
PART– B& C				
1.	Justify why histogram processing is called as an efficient tool for graphical representation of the total distribution in a digital image.	CO2	BTL-2	Understand
2.	i. Perform histogram equalization of the image Gray levels rk 0 1 2 3 4 5 6 7 No. of pixels pk 6 8 11 12 3 5 15 6 ii. Perform histogram equalization of the image.	CO2	BTL-3	Apply

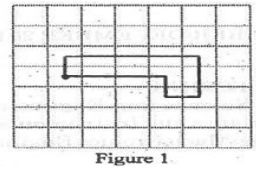
	$\begin{bmatrix} 3 & 2 & 4 & 5 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 5 & 2 & 4 & 4 \end{bmatrix}$			
3.	Discuss homomorphic filtering and explain in detail how it is used in correcting non-uniform illumination in images.	CO2	BTL-2	Understand
4.	i. How low-pass and high-pass filtering is performed in frequency domain given an image? Explain. ii. Apply spatial high-pass filter for the marked pixels in the image. $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 3 & 2 \\ 1 & 5 & 6 \end{bmatrix}$	CO2	BTL-3	Apply
5.	Explain the various enhancement techniques performed in spatial domain.	CO2	BTL-2	Understand
6.	Explain the various enhancement techniques performed in frequency domain.	CO2	BTL-2	Understand
7.	Apply various gray level transformations on an image and discuss its effects in Image Enhancement.	CO2	BTL-3	Apply
8.	Analyze the Gaussian and butterworth low pass filter on an image and discuss its effects. Also give the differences between high pass and low pass filters.	CO2	BTL-4	Analyze
9.	Explain the linear and non linear smoothing spatial filters to enhance the images.	CO2	BTL-2	Understand
10.	Perform histogram equalization and matching for the 3-bit image of size 64 x 64 pixels whose intensity distribution is given below Gray levels r_k 0 1 2 3 4 5 6 7 No. of pixels n_k 790 1023 850 656 329 245 122 81	CO2	BTL-3	Apply
11.	Demonstrate all the piecewise-linear transformation functions used in image enhancement.	CO2	BTL-3	Apply
12.	Justify why histogram processing is called as an efficient tool for graphical representation of the total distribution in a digital image.	CO2	BTL-3	Apply
13.	Explain all the image smoothening filtering mechanism in the frequency domain.	CO2	BTL-2	Understand
14.	Illustrate the histogram specification and its importance in image processing.	CO2	BTL-3	Apply

UNIT III - IMAGE RESTORATION				
CO3: Learn the restoration concepts and filtering techniques.				
PART- A				
Qno	**Questions**	**CO**	**BT**	**Competence**
1.	Distinguish between image enhancement and image restoration.	CO3	BTL-2	Understand
2.	Name the different types of derivative filters in DIP.	CO3	BTL-1	Remember
3.	How an image is segmented using thresholding?	CO3	BTL-2	Understand
4.	State the causes of degradation in an image.	CO3	BTL-1	Remember
5.	Mention two drawbacks of inverse filter.	CO3	BTL-1	Remember
6.	Which filter will be effective in minimizing the impact of "salt and pepper" noise in an image?	CO3	BTL-2	Understand
7.	Give the relation for Gamma noise and Exponential noise.	CO3	BTL-2	Understand
8.	What are the two approaches for blind image restoration?	CO3	BTL-1	Remember
9.	Why the restoration is called as unconstrained restoration?	CO3	BTL-2	Understand
10.	What are the three methods of estimating the degradation function?	CO3	BTL-1	Remember
11.	Define uniform noise in digital images.	CO3	BTL-1	Remember
12.	The harmonic mean filter helps reduce noise. Justify?	CO3	BTL-2	Understand
13.	Define salt and pepper noise.	CO3	BTL-1	Remember
14.	What is spatial restoring filters and its types?	CO3	BTL-1	Remember
15.	Draw block diagram of a model of the image degradation /restoration process.	CO3	BTL-1	Remember
16.	Give the main objective of Wiener filtering and give its expression.	CO3	BTL-1	Remember
17.	What is meant by constrained least square restoration?	CO3	BTL-1	Remember
18.	Define inverse filtering	CO3	BTL-1	Remember
19.	What is pseudo inverse filtering?	CO3	BTL-1	Remember
20.	List the drawbacks of inverse filtering.	CO3	BTL-1	Remember
PART– B& C				
1.	Apply Wiener filtering technique to a degraded image and explain its steps with appropriate examples.	CO3	BTL-3	Apply
2.	Explain adaptive filter. What are the two levels of adaptive median filtering algorithms?	CO3	BTL-2	Understand
3.	Explain the overall process involved in the restoration of image quality and explain all types of noise models.	CO3	BTL-2	Understand
4.	Describe the image restoration technique of inverse filtering. Why inverse filtering approach fails in the presence of noise?	CO3	BTL-2	Understand

5.	Analyze the different ways to estimate the degradation function in Image restoration.	CO3	BTL-4	Analyze
6.	Explain all the spatial filtering approaches used to restore the images in the presence of noise.	CO3	BTL-2	Understand
7.	Explain in detail about the Noise Models with suitable diagram.	CO3	BTL-2	Understand
8.	Explain the Mean and order statistic spatial filters used to restore images.	CO3	BTL-2	Understand
9.	Describe the concept of frequency domain filtering and how it helps in reducing periodic noise in images.	CO3	BTL-2	Understand
10.	Demonstrate the working of bandpass, bandreject, and notch filters in reducing periodic noise with suitable examples.	CO3	BTL-3	Apply
11.	Explain the concept of an optimum notch frequency filter and describe how it helps reduce periodic noise in images.	CO3	BTL-2	Understand
12.	Describe the minimum mean square error (MMSE) filtering technique and explain its role in image restoration.	CO3	BTL-2	Understand
13.	Analyze and compare different filters used for image restoration in the presence and absence of noise.	CO3	BTL-4	Analyze
14.	Compare and contrast inverse filtering and Wiener filtering in terms of performance, assumptions, and use cases in image restoration.	CO3	BTL-4	Analyze

UNIT IV - IMAGE SEGMENTATION				
CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.				
PART- A				
Qno	**Questions**	**CO**	**BT**	**Competence**
1.	How the derivatives are obtained in edge detection during formulation?	CO4	BTL-2	Understand
2.	How the discontinuity is detected in an image using segmentation?	CO4	BTL-2	Understand
3.	Define Image Segmentation. Give an applications of segmentation.	CO4	BTL-1	Remember
4.	How do you detect isolated points in an image?	CO4	BTL-2	Understand
5.	What are the two properties that are followed in image segmentation?	CO4	BTL-1	Remember
6.	What is the role of gradient operator and laplacian operator in segmentation?	CO4	BTL-1	Remember
7.	What are the two properties used for establishing similarity of edge pixels?	CO4	BTL-1	Remember
8.	Specify the steps involved in splitting and merging.	CO4	BTL-1	Remember
9.	What is the use of Dam?	CO4	BTL-1	Remember
10.	What is the idea behind similarity property?	CO4	BTL-1	Remember
11.	Define Laplacian of a Guassian function.	CO4	BTL-1	Remember
12.	List the steps involved in region splitting and merging.	CO4	BTL-1	Remember
13.	What is edge detection?	CO4	BTL-1	Remember
14.	List the properties used for establishing similarity of edge pixels.	CO4	BTL-1	Remember
15.	What is meant by markers?	CO4	BTL-1	Remember
16.	State all the properties followed in image segmentation.	CO4	BTL-1	Remember
17.	What is meant by gradient operators?	CO4	BTL-1	Remember
18.	List the types of thresholding.	CO4	BTL-1	Remember
19.	Define region growing.	CO4	BTL-1	Remember
20.	What is minimum perimeter polygon?	CO4	BTL-1	Remember
PART– B& C				
1.	Explain region splitting and merging technique for image segmentation with suitable examples.	CO4	BTL-2	Understand
2.	i. Discuss the behavior of first and second order derivatives for a step and a ramp edge. ii. How an image is segmented using region growing	CO4	BTL-2	Understand

	technique? Explain.			
3.	i. Explain the process of edge linking using Hough transform. ii. Explain region based segmentation techniques.	CO4	BTL-2	Understand
4.	What is the objective of image segmentation? Explain any one of the region based image segmentation technique in detail. Mention two applications of image segmentation.	CO4	BTL-2	Understand
5.	Explain about the process of edge linking and boundary detection in detail.	CO4	BTL-2	Understand
6.	Summarize the basic concepts of intensity thresholding, and explain how noise, illumination, and reflectance affect the thresholding process.	CO4	BTL-2	Understand
7.	Apply suitable segmentation techniques to extract distinct regions from an image and justify your choice.	CO4	BTL-3	Apply
8.	Explain the concept of edge detection and describe the fundamental steps involved in detecting edges in an image.	CO4	BTL-2	Understand
9.	Explain the concept of dam construction in watershed segmentation and discuss how it helps in image segmentation.	CO4	BTL-2	Understand
10.	Explain the use of first-order derivatives in edge detection and describe how they highlight image discontinuities.	CO4	BTL-2	Understand
11.	Demonstrate the application of morphological watershed segmentation with a sample image and explain the output.	CO4	BTL-3	Apply
12.	Summarize how global thresholding can be improved using image smoothing and edge information.	CO4	BTL-2	Understand
13.	Analyze and compare local processing and regional processing techniques in image segmentation. Highlight their advantages, limitations, and suitable applications.	CO4	BTL-4	Analyze
14.	Differentiate between various morphological operations (e.g., dilation, erosion, opening, closing) and analyze their role in image preprocessing and segmentation.	CO4	BTL-4	Analyze

UNIT V - OBJECT REPRESENTATION AND RECOGNITION				
CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.				
PART- A				
Qno	**Questions**	**CO**	**BT**	**Competence**
1.	Does the use of chain code compress the description information of an object contour?	CO5	BTL-1	Remember
2.	Distinguish between pattern and pattern class.	CO5	BTL-2	Understand
3.	Define training pattern and training set.	CO5	BTL-1	Remember
4.	Obtain the 4 directional chain code for the shape shown in figure 1. The dot in the figure represents the starting point.  Figure 1	CO5	BTL-2	Understand
5.	Give the formula for diameter of boundary.	CO5	BTL-1	Remember
6.	Define skeleton algorithm.	CO5	BTL-1	Remember
7.	Name some boundary descriptors.	CO5	BTL-1	Remember
8.	Define statistical moments.	CO5	BTL-1	Remember
9.	What is Freeman chain code? Give all the uses of chain code.	CO5	BTL-1	Remember
10.	State is the use of signatures in object recognition.	CO5	BTL-1	Remember
11.	Define texture in the context of image processing.	CO5	BTL-1	Remember
12.	Differentiate between boundary descriptors and regional descriptors.	CO5	BTL-2	Understand
13.	What is a pattern and pattern class?	CO5	BTL-1	Remember
14.	State the role of Fourier descriptors in shape analysis.	CO5	BTL-1	Remember
15.	Distinguish between pattern and pattern class.	CO5	BTL-2	Understand
16.	List any two regional descriptors.	CO5	BTL-1	Remember
17.	What are topological features used in object recognition?	CO5	BTL-1	Remember
18.	Distinguish minimum distance and Bayes classifiers for classifying texture patterns.	CO5	BTL-2	Understand
PART- B&C				
1.	Write short on the following image representation techniques (i) Chain code and (ii) Polygonal approximation.	CO5	BTL-2	Understand
2.	Explain in detail any two boundary representation schemes and	CO5	BTL-2	Understand

	illustrate with examples.			
3.	i. What is texture? How texture features are extracted in an image ii. How patterns are recognized based on matching? Explain.	CO5	BTL-3	Apply
4.	Explain in detail about i. Minimum Distance Classifier ii. Bayes Classifier	CO5	BTL-2	Understand
5.	Describe the minimum-perimeter polygon (MPP) algorithm and explain how it is used for object boundary approximation.	CO5	BTL-2	Understand
6.	Illustrate how optimum statistical classifiers are used in pattern recognition tasks and apply them to a given classification problem.	CO5	BTL-3	Apply
7.	Explain the boundary-following algorithm with an example and interpret how it helps in object representation.	CO5	BTL-2	Understand
8.	Illustrate the recognition process based on pattern matching and apply it to a simple object recognition task.	CO5	BTL-3	Apply
9.	Apply regional descriptors to analyze texture in an image and demonstrate how they are used in classification.	CO5	BTL-3	Apply
10.	Compare and contrast the Marr-Hildreth and Canny edge detectors based on edge quality, detection performance, and noise sensitivity.	CO5	BTL-4	Analyze
11.	Explain the concept of chain codes with an example. How does Freeman chain code represent object boundaries?	CO5	BTL-2	Understand
12.	Describe the use of simple boundary descriptors in object representation. What are shape numbers and how are they used to describe shapes?	CO5	BTL-2	Understand
13.	Apply the concept of patterns and pattern classes in solving an object recognition problem.	CO5	BTL-3	Apply
14.	Illustrate the following boundary descriptors with appropriate diagrams or examples: i) Fourier descriptors ii) Statistical moments	CO5	BTL-3	Apply