



SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

(An Autonomous Institution)

DEPARTMENT OF COMPUTER APPLICATIONS

QUESTION BANK



III SEMESTER

PMC104 IMAGE PROCESSING AND MACHINE VISION

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Prepared by

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SUBJECT : PMC104-IMAGE PROCESSING AND MACHINE VISION

SEM / YEAR: III / II

UNIT I-INTRODUCTION				
Background, definition, Digital Image Fundamentals, Origin of DIP, Digital image representation, fundamental steps in image processing, elements of digital image processing systems, image acquisition, storage, processing, communication and display, data structures for image analysis				
Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
PART – A				
1	Define Digital Image Processing (DIP).	BTL-1	Remembering	CO 1
2	What is a digital image? Give its mathematical representation ($f(x,y)$).	BTL-1	Remembering	CO 1
3	Differentiate between analog image and digital image.	BTL-2	Understanding	CO 1
4	Define a pixel. What are the two fundamental components of a digital image?	BTL-1	Remembering	CO 1
5	Trace the origin of Digital Image Processing. Name any two early applications of DIP.	BTL-2	Understanding	CO 1
6	List any four major application areas of Digital Image Processing.	BTL-1	Remembering	CO 1
7	Differentiate between image sampling and image quantization.	BTL-2	Understanding	CO 1
8	Define spatial resolution and gray-level resolution.	BTL-2	Understanding	CO 1
9	What is bit depth in a digital image?	BTL-2	Understanding	CO 1
10	What are image sampling and image quantization?	BTL-1	Remembering	CO 1
11	Differentiate between image sampling and image quantization.	BTL-2	Understanding	CO 1
12	List the fundamental steps involved in Digital Image Processing.	BTL-1	Remembering	CO 1
13	What is image acquisition? State the role of an image sensor.	BTL-2	Understanding	CO 1
14	Name any two devices used for image acquisition.	BTL-1	Remembering	CO 1
15	Define image enhancement. Differentiate it from image restoration.	BTL-2	Understanding	CO 1
16	Define image segmentation and image compression.	BTL-1	Remembering	CO 1
17	What is the purpose of morphological processing in Digital Image Processing?	BTL-2	Understanding	CO 1
18	List the basic elements/components of a Digital Image Processing system.	BTL-1	Remembering	CO 1
19	What is the function of specialized image processing	BTL-2	Understanding	CO 1

	hardware? Why is mass storage required in a DIP system?			
20	Summarize the roles of image communication, display devices, and hardcopy devices in a DIP system.	BTL-2	Understanding	CO 1
21	Explain the role of image communication, display units, and hardcopy devices in a Digital Image Processing system.	BTL-2	Understanding	CO 1
22	Differentiate between short-term image storage and long-term image storage.	BTL-2	Understanding	CO 1
23	Compare chain code and quadtree representations and state one application of each.	BTL-2	Understanding	CO 1
24	An image has a resolution of 1024×768 pixels with 8 bits/pixel. Calculate the storage required in bytes and megabytes.	BTL-2	Understanding (Problem)	CO 1
25	A digital image of size 640×480 pixels uses 24 bits per pixel. Calculate the total memory required to store the image. Also determine the number of bits required to represent 256 gray levels.	BTL-2	Understanding (Problem)	CO 1
PART – B				
1.	Apply the concepts of Digital Image Processing (DIP) to outline its background, definition, and scope. Differentiate DIP from Computer Vision and Computer Graphics, and relate them to major application areas.	BTL-3	Applying	CO 1
2.	Trace and examine the historical evolution of Digital Image Processing from its origin to modern systems. Identify the major milestones and analyze their contributions to the development of contemporary DIP technologies.	BTL-4	Analyzing	CO 1
3.	Demonstrate the principles of digital image fundamentals by illustrating sampling, quantization, spatial resolution, gray-level resolution, and bit depth. Relate each concept to the resulting image quality.	BTL-3	Applying	CO 1
4.	(a) Formulate the mathematical representation of a digital image using the two-dimensional function $f(x,y)$. (8 Marks) (b) Examine the effects of varying spatial resolution and gray-level resolution on image quality using suitable examples. (8 Marks)	BTL-4	Analyzing	CO 1
5.	Construct a suitable flow of the fundamental stages involved in Digital Image Processing using a neat block diagram. Illustrate the purpose of image acquisition, enhancement, restoration, segmentation, representation, recognition, and compression at each stage.	BTL-3	Applying	CO 1
6.	Differentiate image enhancement and image restoration based on their objectives, processing methods, and applications. Examine how each technique contributes to the overall Digital Image Processing pipeline with suitable examples.	BTL-4	Analyzing	CO 1
7.	Illustrate the architecture of a general-purpose Digital Image Processing system using a neat block diagram. Analyze the function and interaction of each major component involved in image processing.	BTL-4	Analyzing	CO 1
8.	Demonstrate the image acquisition process by relating	BTL-3	Applying	CO 1

	image sensors, digitization, sampling, and quantization to the conversion of a real-world scene into a digital image.			
9.	Assess the storage requirements of a Digital Image Processing system by comparing short-term, online, and archival storage in terms of capacity, access speed, cost, and applications.	BTL-5	Evaluating	CO 1
10.	Investigate the hardware and software components employed in Digital Image Processing systems. Evaluate how specialized image-processing hardware contributes to improved computational speed and overall system performance.	BTL-5	Evaluating	CO 1
11.	Illustrate the role of image communication and networking in Digital Image Processing systems. Analyze the major challenges in transmitting large image datasets and determine suitable approaches for efficient transmission.	BTL-4	Analyzing	CO 1
12.	Assess the functions of display devices and hardcopy devices in Digital Image Processing systems. Examine the factors that influence image quality during electronic display and printing.	BTL-5	Evaluating	CO 1
13.	Demonstrate the use of different data structures for image analysis, including image matrices, chain codes, run-length encoding, quadrees, and hierarchical structures, with suitable examples.	BTL-3	Applying	CO 1
14.	Compare chain code, run-length encoding, quadtree, and image matrix representations with respect to storage efficiency, computational complexity, and application suitability. Determine the most appropriate representation for different image-analysis tasks.	BTL-5	Evaluating	CO 1
15.	Calculate the storage requirement of a grayscale image having a resolution of 2048×1024 pixels with 8 bits/pixel. Recalculate the requirement when the bit depth is increased to 16 bits/pixel, and assess the resulting effects on image quality, storage capacity, and transmission efficiency.	BTL-5	Evaluating	CO 1
16.	Design a complete Digital Image Processing system for a satellite imaging organization that can acquire, store, process, and transmit high-resolution remote-sensing images. Select appropriate image sensors, storage strategies, processing hardware, communication methods, and display devices, and justify each choice.	BTL-6	Creating	CO 1
17.	Evaluate the storage requirements of a medical imaging center handling MRI and CT images. Recommend appropriate data structures, including quadrees and run-length encoding, along with suitable image-processing techniques, and justify their selection for efficient storage, retrieval, and analysis.	BTL-5	Evaluating	CO 1
18.	Formulate an optimal Digital Image Processing architecture for a smart surveillance system that captures live video, performs real-time processing, and transmits alerts through a limited-bandwidth network. Justify the selection of	BTL-6	Creating	CO 1

	acquisition devices, storage methods, processing hardware, compression techniques, communication protocols, and display systems.			
UNIT II IMAGE ENHANCEMENT				
Image Enhancement in the spatial domain (Basic gray level transformations, histogram processing, Enhancement using arithmetic/logic operations, Basics of spatial filtering comparison between smoothing and sharpening spatial filters), Image Enhancement in the frequency domain (1D Fourier transform-2D Fourier transform and its Inverse-Smoothing & sharpening frequency domain filters (Ideal, Butterworth, Gaussian), homomorphic filtering)				
Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
PART – A				
1.	Define Image Enhancement. State its objective.	BTL-1	Remembering	CO 2
2.	Differentiate between spatial domain and frequency domain image enhancement.	BTL-2	Understanding	CO 2
3.	Describe a gray-level transformation.	BTL-1	Remembering	CO 2
4.	Write the mathematical expression for image negative transformation. State one application.	BTL-1	Remembering	CO 2
5.	Describe log transformation and mention when it is used in image enhancement.	BTL-2	Understanding	CO 2
6.	Illustrate the power-law (Gamma) transformation equation and explain the effect of gamma correction on an image.	BTL-2	Understanding	CO 2
7.	State the meaning of gray-level slicing and bit-plane slicing.	BTL-1	Remembering	CO 2
8.	Identify the histogram of a digital image and state the information it represents.	BTL-1	Remembering	CO 2
9.	Summarize the concept of Histogram Equalization.	BTL-2	Understanding	CO 2
10.	Describe the objective of Histogram Matching (Specification).	BTL-2	Understanding	CO 2
11.	List any two arithmetic operations used in image enhancement. State one application of image subtraction.	BTL-1	Remembering	CO 2
12.	Illustrate the purpose of logical AND and logical OR operations in image processing.	BTL-2	Understanding	CO 2
13.	Define spatial filtering and specify the meaning of a spatial mask (kernel).	BTL-1	Remembering	CO 2
14.	Contrast smoothing filters with sharpening filters.	BTL-2	Understanding	CO 2
15.	Specify the function of a mean (averaging) filter and mention one application.	BTL-1	Remembering	CO 2
16.	State why a median filter is preferred for removing impulse noise.	BTL-2	Understanding	CO 2
17.	Describe the purpose of the Laplacian filter in image sharpening.	BTL-2	Understanding	CO 2
18.	State the definition of the 1D Fourier Transform.	BTL-1	Remembering	CO 2
19.	Write the mathematical expression for the 2D Discrete Fourier Transform (DFT).	BTL-1	Remembering	CO 2
20.	What is the purpose of the Inverse Fourier Transform (IFT)?	BTL-2	Understanding	CO 2

21.	Interpret the concept of frequency domain filtering.	BTL-2	Understanding	CO 2
22.	Compare Ideal, Butterworth, and Gaussian frequency domain filters.	BTL-2	Understanding	CO 2
23.	Describe the ringing effect, identify the filter that commonly produces it, and state how the Butterworth filter reduces it.	BTL-2	Understanding	CO 2
24.	Discuss Homomorphic Filtering and state its application in image enhancement.	BTL-2	Understanding	CO 2
25.	Determine the output gray level after applying the negative transformation to an image with gray levels 0–255 for an input pixel value of 80. OR State the effect of applying a 3×3 averaging filter to a noisy image.	BTL-2	Understanding	CO 2
PART –B				
1.	Describe the fundamental concept, objectives and importance of Image Enhancement. Differentiate between spatial-domain and frequency-domain enhancement techniques with suitable examples.	BTL-2	Understand	CO2
2.	Discuss the different gray-level transformation techniques such as negative, logarithmic, power-law and piecewise-linear transformations. Illustrate their characteristics and applications.	BTL-2	Understand	CO2
3.	Analyze the principles of gray-level slicing and bit-plane slicing. Compare background-preserving and non-background-preserving slicing and discuss their applications in image enhancement.	BTL-2	Understand	CO2
4.	Analyze the concept of Histogram Processing. Explain Histogram Equalization and Histogram Matching, including their transformation functions, advantages and applications.	BTL-4	Analyze	CO2
5.	Examine the role of arithmetic and logical operations in image enhancement. Discuss image addition, subtraction, multiplication, division, AND, OR, XOR and NOT operations with suitable applications.	BTL-4	Analyze	CO2
6.	Illustrate the fundamentals of spatial filtering, including masks, kernels, convolution and neighbourhood processing. Differentiate between linear and non-linear spatial filters.	BTL-2	Understand	CO2
7.	Compare smoothing filters such as mean, weighted mean, median and Gaussian filters. Explain their noise-reduction characteristics and suitable applications.	BTL-4	Analyze	CO2
8.	Assess the different image sharpening techniques, including Laplacian, Sobel, Prewitt, unsharp masking and high-boost filtering. Compare their edge-enhancement capabilities.	BTL-5	Evaluate	CO2
9.	Summarize the principles of 1-D and 2-D Fourier Transform, DFT and inverse DFT. Discuss important properties of the Fourier transform used in image processing.	BTL-2	Understand	CO2
10.	Evaluate Ideal, Butterworth and Gaussian Low-Pass and	BTL-5	Evaluate	CO2

	High-Pass Filters in the frequency domain. Discuss ringing effects, transition characteristics and their influence on image quality.			
11.	For the following 4×4 image, $f(x, y) = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{bmatrix}$ Perform the 2-D DFT. Obtain the Fourier coefficients and sketch/represent the corresponding magnitude spectrum.	BTL-3	Apply	CO2
12.	Determine the Histogram Equalization result for an image containing 64 pixels and 8 gray levels (0–7) with frequencies 8, 6, 10, 14, 12, 7, 5, 2. (a) Calculate histogram probability, CDF and transformation function – 8 Marks. (b) Obtain the equalized gray levels and output histogram – 8 Marks.	BTL-3	Apply	CO2
13.	Obtain the Histogram Matching result for an input histogram [5, 8, 12, 10, 9, 8, 7, 5] and desired histogram [4, 6, 8, 10, 12, 10, 8, 6], for 64 pixels and gray levels 0–7. (a) Determine the two probability distributions and CDFs – 8 Marks. (b) Calculate the mapping function and output histogram – 8 Marks.	BTL-3	Apply	CO2
14.	Compute the output of a 3×3 mean, median and weighted averaging filter for the given spatial-domain image $\begin{bmatrix} 10 & 20 & 30 \\ 20 & 40 & 60 \\ 30 & 50 & 70 \end{bmatrix}$. Obtain the centre-pixel values for each filter and compare their smoothing performance.	BTL-4	Analyze	CO2
15.	Apply the Laplacian and Sobel filters to the given image matrix. $\begin{bmatrix} 10 & 10 & 10 \\ 10 & 50 & 50 \\ 10 & 50 & 90 \end{bmatrix}$ (a) Calculate the Laplacian response and sharpened centre pixel – 8 Marks. (b) Determine the horizontal gradient, vertical gradient and gradient magnitude using Sobel masks – 8 Marks.	BTL-4	Analyze	CO2
16.	a) Explain the basics of spatial filtering, including the concept of a spatial mask/kernel, convolution process, and neighborhood processing with a neat diagram. b) Find the sharpened center pixel using the Laplacian mask $\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$ for the image matrix $\begin{bmatrix} 10 & 20 & 10 \\ 20 & 50 & 20 \\ 10 & 20 & 10 \end{bmatrix}$.	BTL-4	Analyze	CO2
17.	Evaluate the frequency response of Ideal, Butterworth and Gaussian filters for the specified cutoff frequency and frequency coordinates. (a) Calculate the filter responses – 8	BTL-5	Evaluate	CO2

	Marks. (b) Compare their attenuation, transition behaviour and ringing characteristics – 8 Marks.			
18.	Consider the following 4×4 spatial-domain image: $f(x, y) = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$ Convert the given spatial-domain image into the frequency domain using the 2-D Discrete Fourier Transform (DFT). Choose $a = 0$ and $b = 0$. Show the step-by-step procedure, including the formation of the Fourier transform matrix and calculation of the frequency-domain representation.	BTL-6	Create	CO2

UNIT III IMAGE COMPRESSION AND SEGMENTATION

Image compression (Fundamentals, Error-free compression, Huffman coding, block coding, constant area coding, variable length coding, bit-plane coding, lossless predictive coding-source and channel encoding-decoding- Lossy compression, lossy predictive coding, transform coding.), Image Segmentation (Thresholding, Edge Based Segmentation, Region Based Segmentation, Mean shift segmentation, Graph cut algorithm, Matching, Evaluation Issues in Segmentation, Watersheds)

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
PART – A				
1.	Define Image Compression and state its objectives.	BTL-1	Remembering	CO 3
2.	Identify data redundancy in image compression and list its different types.	BTL-1	Remembering	CO 3
3.	Differentiate between Lossless Compression and Lossy Compression.	BTL-2	Understanding	CO 3
4.	State Compression Ratio and its significance in image compression.	BTL-1	Remembering	CO 3
5.	Describe the meaning of Error-free (Lossless) Compression.	BTL-1	Remembering	CO 3
6.	Define Huffman Coding and mention one advantage of using it.	BTL-1	Remembering	CO 3
7.	Identify the property that makes Huffman Coding optimal among instantaneous codes.	BTL-2	Understanding	CO 3
8.	Outline the concept of Block Coding in image compression.	BTL-1	Remembering	CO 3
9.	Specify Constant Area Coding (CAC) and mention its basic principle.	BTL-1	Remembering	CO 3
10.	Summarize Variable Length Coding (VLC) and state why variable-length codewords are used.	BTL-2	Understanding	CO 3
11.	Define Bit-Plane Coding and state one of its applications in image compression.	BTL-1	Remembering	CO 3
12.	Characterize Lossless Predictive Coding and state the role of a predictor in the coding process.	BTL-2	Understanding	CO 3
13.	Distinguish between Source Encoding and Channel Encoding.	BTL-2	Understanding	CO 3
14.	State the purpose of Channel Decoding in a communication	BTL-1	Remembering	CO 3

	system.			
15.	Differentiate Lossy Predictive Coding and Transform Coding. Name any two transforms used in transform coding.	BTL-2	Understanding	CO 3
16.	Define Image Segmentation and state its primary objective.	BTL-1	Remembering	CO 3
17.	Compare Global Thresholding and Adaptive Thresholding in image segmentation.	BTL-2	Understanding	CO 3
18.	Identify Edge-Based Segmentation and name any two edge detection operators.	BTL-2	Understanding	CO 3
19.	Characterize Region-Based Segmentation and state its basic principle.	BTL-1	Remembering	CO 3
20.	Contrast Region Growing with Region Splitting and Merging.	BTL-2	Understanding	CO 3
21.	Define Mean Shift Segmentation and state its main purpose.	BTL-1	Remembering	CO 3
22.	Summarize the Graph Cut Algorithm and mention one application in image segmentation.	BTL-2	Understanding	CO 3
23.	State the basic concept of the Watershed Algorithm in image segmentation.	BTL-1	Remembering	CO 3
24.	Clarify the meaning of Matching in image segmentation and state why segmentation evaluation is important.	BTL-2	Understanding	CO 3
25.	Relate symbol frequency to codeword length in Huffman Coding and state how this relationship improves compression efficiency.	BTL-2	Understanding	CO 3
PART –B				
1.	Apply the concepts of coding redundancy, interpixel redundancy and psychovisual redundancy to a digital image. Illustrate each type with a suitable example and discuss its influence on compression.	BTL-3	Applying	CO3
2.	Construct a Huffman coding procedure for a given set of symbols and probabilities. (a) Build the Huffman tree and generate the corresponding codewords – 8 Marks. (b) Determine the average code length and compression efficiency – 8 Marks.	BTL-3	Applying	CO3
3.	Demonstrate the working principles of Error-Free (Lossless) Compression techniques, including Block Coding, Constant Area Coding (CAC), Variable Length Coding (VLC), and Bit-Plane Coding, with suitable examples and applications.	BTL-3	Applying	CO3
4.	Discuss Lossless Predictive Coding in detail, including the predictor, encoder, decoder, source encoding, and channel encoding/decoding with a neat block diagram	BTL-3	Applying	CO3
5.	Demonstrate Lossy Predictive Coding (DPCM) by describing the functions of the predictor, quantizer, encoder and decoder. Include a suitable block diagram and trace the signal flow through the system.	BTL-3	Applying	CO3
6.	Develop a Transform Coding model for image compression. (a) Illustrate transformation and quantization stages – 8 Marks. (b) Describe encoding and reconstruction	BTL-3	Applying	CO3

	stages with a suitable example – 8 Marks.			
7.	Analyze Lossless and Lossy Compression with respect to compression ratio, reconstructed image quality, computational complexity, storage efficiency and practical applications.	BTL-4	Analyzing	CO3
8.	Examine Image Segmentation by identifying its objectives, importance and major categories of segmentation techniques used in Digital Image Processing.	BTL-4	Analyzing	CO3
9.	Analyze Thresholding-based Image Segmentation by considering Global, Adaptive and Optimal Thresholding. Compare their operating principles and suitability for different image conditions.	BTL-4	Analyzing	CO3
10.	Assess Edge-Based Segmentation using Sobel, Prewitt, Roberts and Canny operators. Compare their edge-detection characteristics and discuss the role of edge linking in forming meaningful regions.	BTL-4	Analyzing	CO3
11.	Differentiate Region Growing and Region Splitting/Merging based on region formation, homogeneity criteria, computational requirements and applications. Include suitable diagrams to illustrate the processes.	BTL-4	Analyzing	CO3
12.	Evaluate Mean Shift Segmentation with respect to its mathematical basis, algorithmic procedure, advantages, limitations and practical applications.	BTL-5	Evaluating	CO3
13.	Compare Edge-Based and Region-Based Segmentation techniques in terms of accuracy, computational complexity, robustness and suitability for different image types. Recommend an appropriate technique for a specified application.	BTL-5	Evaluating	CO3
14.	Assess the Graph Cut Algorithm as an energy-minimization approach for image segmentation. (a) Formulate segmentation using the energy/min-cut concept – 8 Marks. (b) Illustrate the min-cut/max-flow procedure and discuss its segmentation result – 8 Marks.	BTL-5	Evaluating	CO3
15.	Design a Watershed-based segmentation procedure for an image containing multiple touching objects. (a) Construct the basic watershed segmentation stages – 8 Marks. (b) Design a marker-controlled approach to reduce over-segmentation and discuss segmentation evaluation – 8 Marks.	BTL-6	Creating	CO3
16.	a) Given the following symbols and probabilities: A = 30, B = 25, C = 20, D = 15, E = 10. Construct the Huffman Tree and determine the Huffman code for each symbol. Also calculate the average code length, entropy, coding efficiency, and compression ratio. b) Given a set of symbols with probabilities A = 40, B = 20, C = 20, D = 10, E = 10, construct the Huffman Tree, generate Huffman codes, calculate the average code length, determine the compression ratio, and comment on the coding efficiency.	BTL-3	Applying	CO3

17.	Determine the output of a lossless predictive coding system for a given sequence of image pixels using a specified predictor. (a) Calculate the prediction errors and encoded values – 8 Marks. (b) Reconstruct the original pixel sequence at the decoder and verify error-free recovery – 8 Marks.	BTL-4	Analyzing	CO3
18.	Evaluate a segmentation problem using a given image matrix and threshold/region information. (a) Perform the specified thresholding or region-based segmentation and obtain the segmented image – 8 Marks. (b) Calculate suitable segmentation measures and assess the quality of the obtained segmentation – 8 Marks.	BTL-5	Evaluating	CO3

UNIT IV COLOR IMAGE PROCESSING

Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images.

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
PART – A				
1.	Define the fundamentals of color used in Digital Image Processing.	BTL-1	Remembering	CO4
2.	Identify the three characteristics of color: Brightness (Intensity), Hue and Saturation.	BTL-1	Remembering	CO4
3.	Differentiate between additive and subtractive color mixing.	BTL-2	Understanding	CO4
4.	Name any four commonly used color models and state their basic purpose.	BTL-1	Remembering	CO4
5.	Outline the basic structure and working principle of the RGB Color Model.	BTL-2	Understanding	CO4
6.	Specify the CMY/CMYK Color Model and identify its major application area.	BTL-1	Remembering	CO4
7.	Describe the HSI Color Model and state why it is useful in image processing applications.	BTL-2	Understanding	CO4
8.	Contrast the RGB and HSI Color Models with respect to their components and applications.	BTL-2	Understanding	CO4
9.	Define Pseudo-color Image Processing and state its basic purpose.	BTL-1	Remembering	CO4
10.	Summarize the concept of intensity slicing in pseudo-color image processing.	BTL-2	Understanding	CO4
11.	Characterize Gray-level to Color Transformation and state its basic principle.	BTL-2	Understanding	CO4
12.	List any two applications of pseudo-color image processing.	BTL-1	Remembering	CO4
13.	Differentiate Full-Color Image Processing from pseudo-color image processing.	BTL-2	Understanding	CO4
14.	Compare per-color-component processing and vector-based processing in full-color image processing.	BTL-2	Understanding	CO4
15.	State the general form of a color transformation function	BTL-1	Remembering	CO4

	and identify its purpose.			
16.	Describe Color Complement and mention one application of color complement.	BTL-2	Understanding	CO4
17.	Define Color Slicing and state its purpose in color image processing.	BTL-1	Remembering	CO4
18.	Summarize the concept of Tone Correction in color transformation.	BTL-2	Understanding	CO4
19.	Characterize Histogram Processing in color images and state its purpose.	BTL-2	Understanding	CO4
20.	Differentiate Color Image Smoothing from Color Image Sharpening.	BTL-2	Understanding	CO4
21.	Identify Color Segmentation and name one color space commonly used for this purpose.	BTL-1	Remembering	CO4
22.	Describe the basis of segmentation in the HSI color space.	BTL-2	Understanding	CO4
23.	Define noise in color images and mention any two common types of noise.	BTL-1	Remembering	CO4
24.	Calculate the number of bits allocated to each RGB component when a color image is represented using 24 bits per pixel.	BTL-2	Understanding	CO4
25.	Recommend a suitable color model for skin detection in face recognition and state the reason for its suitability.	BTL-2	Understanding	CO4
PART –B				
1.	Apply the principles of color fundamentals by relating the characteristics of light, additive and subtractive color theory, primary and secondary colors, and Hue, Saturation and Brightness (HSB) to image-processing applications.	BTL-3	Applying	CO4
2.	Compare the RGB, CMY/CMYK, HSI, HSV and YCbCr color models with respect to structure, characteristics, advantages, limitations and applications. Support the comparison with suitable diagrams.	BTL-4	Analyzing	CO4
3.	Derive the mathematical relationships for RGB, CMY and HSI color models. Obtain the conversion equations for $RGB \leftrightarrow CMY$ and $RGB \leftrightarrow HSI$, and interpret their significance.	BTL-4	Analyzing	CO4
4.	Demonstrate Pseudo-color Image Processing using Intensity Slicing and Gray-level-to-Color Transformation. Illustrate the processing stages, color mapping and practical applications with suitable diagrams.	BTL-3	Applying	CO4
5.	Differentiate per-component processing and vector-based processing in Full-Color Image Processing. Assess their processing requirements, advantages and suitable applications.	BTL-4	Analyzing	CO4
6.	Construct a color transformation framework incorporating linear and nonlinear transformations, color complements and color slicing. Relate each transformation to a suitable practical application.	BTL-3	Applying	CO4
7.	Analyze Tone Correction and Histogram Processing for color images. Compare histogram equalization applied independently to RGB components with equalization of the	BTL-4	Analyzing	CO4

	intensity component in the HSI model.			
8.	Evaluate the role of color-space transformations in image enhancement, compression, segmentation and object recognition. Compare RGB and HSI with respect to their suitability for these applications.	BTL-5	Evaluating	CO4
9.	Apply Mean, Median and Gaussian smoothing techniques to full-color images for noise reduction. Discuss the effect of independently processing the color components.	BTL-3	Applying	CO4
10.	Assess Laplacian-based and High-pass sharpening techniques for color images. Examine the precautions required to avoid false colors and artifacts during multi-channel sharpening.	BTL-5	Evaluating	CO4
11.	Investigate the effects of smoothing and sharpening in RGB and HSI color spaces. Compare their results with respect to noise suppression, edge preservation and color consistency.	BTL-4	Analyzing	CO4
12.	Develop a color segmentation procedure using RGB and HSI color spaces. Incorporate threshold-based, region-based and clustering-based approaches and select suitable methods for different image conditions.	BTL-6	Creating	CO4
13.	Assess the challenges and effectiveness of color segmentation in comparison with grayscale segmentation. Recommend appropriate applications based on robustness, computational requirements and color information.	BTL-5	Evaluating	CO4
14.	Analyze Gaussian, Salt-and-Pepper and Speckle noise in color images. Compare appropriate detection and filtering techniques and determine their suitability for different noise conditions.	BTL-4	Analyzing	CO4
15.	Calculate the RGB component allocation for a 24-bit color image and determine the number of possible colors represented. (a) Determine the bits assigned to each RGB component and possible intensity levels – 8 Marks. (b) Calculate the total number of representable colors and relate the result to color-image quality – 8 Marks.	BTL-3	Applying	CO4
16.	Determine the output of a specified color transformation for a given RGB pixel set. (a) Convert the given RGB values into the required color model using the appropriate transformation equations – 8 Marks. (b) Interpret the resulting color components and determine their suitability for enhancement or segmentation – 8 Marks.	BTL-4	Analyzing	CO4
17.	Design a pseudo-color processing system for a grayscale medical image to improve visualization. (a) Apply Intensity Slicing or Gray-level-to-Color Transformation to obtain the pseudo-color representation – 8 Marks. (b) Justify the selected color mapping with respect to visualization of diagnostically important regions – 8 Marks.	BTL-6	Creating	CO4
18.	Formulate a complete color image-processing pipeline for an automated fruit-sorting system operating under varying	BTL-6	Creating	CO4

	illumination. (a) Select and apply an appropriate color model, color transformation, segmentation and noise-removal technique – 8 Marks. (b) Integrate smoothing and sharpening stages and justify the complete processing sequence for reliable ripeness classification – 8 Marks.			
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UNIT V MACHINE VISION

Introduction, definition, Active vision system, Machine vision components, hardware's and algorithms, image function and characteristics, segmentation, data reduction, feature extraction, edge detection, image recognition and decisions, application of machine vision such as in inspection of parts, identification, industrial robot control, mobile robot application, Competing technologies, CCD line scan and area scan sensor, Videcon and other cameras, Triangulation geometry, resolution passive and active stereo imaging, laser scanner, data processing.

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
PART – A				
1.	Define Machine Vision and state its primary objective.	BTL-1	Remembering	CO5
2.	Differentiate between Machine Vision and Computer Vision based on their purpose and applications.	BTL-2	Understanding	CO5
3.	Identify an Active Vision System and state its basic operating principle.	BTL-1	Remembering	CO5
4.	Distinguish between Active Vision and Passive Vision systems based on illumination and sensing mechanisms.	BTL-2	Understanding	CO5
5.	List the major functional components of a Machine Vision system.	BTL-1	Remembering	CO5
6.	Name the hardware components commonly used in a Machine Vision system and state their basic functions.	BTL-1	Remembering	CO5
7.	Describe the role of algorithms in acquiring, processing and interpreting images in a Machine Vision system.	BTL-2	Understanding	CO5
8.	Define an image function in Machine Vision and state its significance.	BTL-1	Remembering	CO5
9.	Identify any two important image characteristics used for machine vision applications.	BTL-1	Remembering	CO5
10.	Summarize the purpose of image segmentation in Machine Vision and indicate why it is required.	BTL-2	Understanding	CO5
11.	Define data reduction in Machine Vision and state its purpose.	BTL-1	Remembering	CO5
12.	Describe the concept of feature extraction and its role in object recognition.	BTL-2	Understanding	CO5
13.	Mention any two image features commonly extracted for recognition.	BTL-1	Remembering	CO5
14.	State the meaning of edge detection and indicate its significance in Machine Vision.	BTL-2	Understanding	CO5
15.	Define image recognition and identify its role in a Machine Vision system.	BTL-1	Remembering	CO5
16.	Outline the purpose of the decision-making stage in a Machine Vision system.	BTL-2	Understanding	CO5
17.	Mention any two applications of Machine Vision in industrial inspection or identification.	BTL-1	Remembering	CO5

18.	Describe the use of Machine Vision in industrial robot control.	BTL-2	Understanding	CO5
19.	Identify one application of Machine Vision in mobile robotics and state its purpose.	BTL-1	Remembering	CO5
20.	List the major competing technologies used as alternatives to Machine Vision systems.	BTL-1	Remembering	CO5
21.	Compare CCD Line Scan and CCD Area Scan sensors with respect to image acquisition and applications.	BTL-2	Understanding	CO5
22.	Specify the characteristics of a Vidicon camera and state one advantage of CCD cameras over Vidicon cameras.	BTL-2	Understanding	CO5
23.	Describe the basic concept of Triangulation Geometry used in Machine Vision.	BTL-2	Understanding	CO5
24.	Contrast Passive Stereo Imaging with Active Stereo Imaging based on sensing and illumination requirements.	BTL-2	Understanding	CO5
25.	Select a suitable imaging device—CCD Line Scan, CCD Area Scan or Laser Scanner—for inspecting fast-moving objects on a conveyor belt, and state the reason for the selection.	BTL-2	Understanding	CO5
PART –B				
1.	Describe the introduction, definition, objectives and scope of Machine Vision. Compare Machine Vision with Human Vision and Computer Vision using suitable examples.	BTL-3	Applying	CO5
2.	Analyze the concept of an Active Vision System and distinguish it from a Passive Vision System with respect to sensor movement, control strategy, advantages and applications.	BTL-4	Analyzing	CO5
3.	Illustrate the major components of a Machine Vision System, including image acquisition hardware, processing hardware, software, sensors, lighting and algorithms, using a neat block diagram.	BTL-3	Applying	CO5
4.	Examine the image function and its important characteristics in Machine Vision. Relate image representation to the requirements of image analysis.	BTL-4	Analyzing	CO5
5.	Demonstrate the roles of Image Segmentation and Data Reduction in a Machine Vision system. Analyze their contribution to recognition accuracy and computational efficiency.	BTL-3	Applying	CO5
6.	Apply suitable Feature Extraction techniques to Machine Vision problems involving geometric, statistical, texture and shape features. Illustrate each category with an appropriate example.	BTL-3	Applying	CO5
7.	Analyze Edge Detection techniques used in Machine Vision and assess their importance in object boundary extraction, dimensional measurement and recognition.	BTL-4	Analyzing	CO5
8.	Construct the sequence of Image Recognition and Decision Making stages in a Machine Vision system, from image acquisition through final decision, using a neat block diagram.	BTL-3	Applying	CO5
9.	Develop a Machine Vision pipeline for industrial parts	BTL-3	Applying	CO5

	inspection. Include image acquisition, illumination, preprocessing, segmentation, feature extraction, recognition and final inspection decisions.			
10.	Demonstrate the use of Machine Vision for identification applications such as barcode reading, OCR and object identification. Relate the processing stages to suitable industrial examples.	BTL-3	Applying	CO5
11.	Design the integration of Machine Vision with Industrial Robot Control. Illustrate vision-guided robotic manipulation and feedback control using a suitable application.	BTL-6	Creating	CO5
12.	Assess the application of Machine Vision in Mobile Robots by examining navigation, localization, obstacle detection, object recognition and real-time processing requirements.	BTL-5	Evaluating	CO5
13.	Evaluate Machine Vision against competing inspection technologies with respect to accuracy, speed, cost, flexibility, reliability and industrial suitability.	BTL-5	Evaluating	CO5
14.	Compare CCD Line Scan and CCD Area Scan Sensors by analyzing their working principles, advantages, limitations and industrial applications.	BTL-4	Analyzing	CO5
15.	Investigate Vidicon Cameras and other camera technologies used in Machine Vision. Compare their characteristics and performance with CCD-based cameras.	BTL-4	Analyzing	CO5
16.	Derive the principles of Triangulation Geometry for depth measurement. Compare Passive Stereo and Active Stereo Imaging and relate image resolution to depth estimation accuracy.	BTL-4	Analyzing	CO5
17.	Design an automated Machine Vision architecture for an automobile plant inspecting car body panels for dents, scratches and dimensional accuracy on a high-speed conveyor. (a) Select suitable sensors, lighting, segmentation, feature extraction and inspection algorithms – 8 Marks. (b) Evaluate CCD cameras against Laser Scanners for this application and justify the preferred technology – 8 Marks.	BTL-5	Evaluating	CO5
18.	Formulate a complete Machine Vision solution for a mobile robot operating in an unstructured warehouse. (a) Select and justify Passive Stereo, Active Stereo or Laser Scanner for navigation, obstacle detection and depth estimation – 8 Marks. (b) Develop the feature extraction, recognition and data-processing pipeline considering accuracy, speed, cost and real-time performance – 8 Marks.	BTL-6	Creating	CO5
