# INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

## COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

## QUESTION BANK

| Course Title | **IMAGE PROCESSING** | | | | |
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| Course Code | AECC26 | | | | |
| Program | B.Tech | | | | |
| Semester | IV | CSIT | | | |
| Course Type | Professional Elective-I | | | | |
| Regulation | IARE - UG20 | | | | |
| Course Structure | Theory | | | Practical | |
| | Lecture | Tutorials | Credits | Laboratory | Credits |
| | 3 | - | 3 | - | - |
| Course Coordinator | Ms.B Lakshmi Prasanna , Assistant Professor | | | | |

## COURSE OBJECTIVES:

**The students will try to learn:**

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| I | The fundamental concepts of digital image processing system and its components. |
| II | The image enhancement, segmentation and compression techniques in spatial and frequency domains. |
| III | The processing steps included in colour image model construction and enhancement. |
| IV | The algorithms used to solve image processing problems to meet design specifications of various applications like Industry, medicine and defence. |

## COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

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| CO 1 | **Interpret** the principles and terminology of digital image processing for describing the features of image. | Understand |
| CO 2 | **Illustrate** mathematical tools used in image intensity transformations for quality enhancement. | Apply |
| CO 3 | **Identify** image enhancement technique to improve the quality. | Apply |
| CO 4 | **Apply** filters on spatial and frequency domainsfor restoring and reducing the noise in a given image. | Apply |
| CO 5 | **Summarize** color models and transformation processing techniques for color image enhancement and compression. | Understand |

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| CO 6 | **Apply** region based morphological operations and edge- based image segmentation techniques for detection of objects in images to remove the imperfections in the structure of the image. | Apply |

## QUESTION BANK:

| MODULE I | | | | |
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| INTRODUCTION | | | | |
| PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS | | | | |
| **Q.No** | **QUESTION** | **Taxonomy** | **How does this subsume the level** | **CO's** |
| 1 | Obtain the image processing matrix for N = 8 and know how it is constructed. | Apply | The learner to **Recall** the image pixel transformation and **Understand** basis function and apply haar transformation for N=8 . | CO2 |
| 2 | Determine the arithmetic by image operations between the following images pixels. $\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$ $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ | Understand | The learner to **Recall** the representation of digital image and **Understand** the mage operations and understand the convolution and correlation property on image. | CO 1 |
| 3 | A common measure of transmission for digital data is baud rate defined by number of bits transmitted per second. Find how many minutes it would take to transmit a 2048*2048 images with 256 intensity levels using a 33.6k baud modem. | Understand | The learner to **Recall** the size of the image , and **Understand** grey levels, baud rate and apply for the calculation of time taken for the image . | CO 1 |

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| 4 | Compute the Pixel Relationships transform of the N=2,and N=4 image | Apply | The learner to **Recall** the image transforms and **Understand** basis function and apply Pixel Relationships for N=2 and 4 . | CO2 |
| 5 | Obtain the intensity transformation matrix For N=8. | Apply | The learner to **Recall** the representation of digital image and **Understand** basis function apply intensity transformation matrix For N=8. | CO2 |
| 6 | Compute the pixel relations of the 4 × 4 grayscale image f(x, y) shown below. $(x, y) = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{bmatrix}$ | Apply | The learner to **Recall** the representation of digital image and **Understand** the properties of Pixel Relationships and apply it on image coefficients f(x,y). | CO 2 |
| 7 | Compute the Inverse image operation of the transform coefficients F(k, l ) given below. $f(k, l) = \begin{bmatrix} 16 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ | Apply | The learner to **Recall** the representation of digital image and **Understand** the properties of pixel relationships and apply it on transform coefficients F (k,l). | CO 2 |
| 8 | Obtain the intensity transform basis for the following matrix of samples $f(m, n) = \begin{bmatrix} 4 & -2 \\ -1 & 3 \end{bmatrix}$ | Apply | The learner to **Recall** the representation of digital image and **Understand** the properties of Pixel Relationships and apply KL transform of the 2 x 2 image | CO2 |

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| 9 | Obtain the spatial and gray level resolutions with one example. | Apply | The learner to **Recall** the representation of digital image and **Understand** the properties of Reverse transformation and apply hadamard forward and reverse transformation | CO2 |
| 10 | Obtain the Noise model of matrix for N = 4 and verify that it obeys the orthogonality property. | Analyze | The learner to **Recall** the representation of digital image and **Understand** the properties of Noise model and analyze the matrix for N=4 . | CO2 |
| **PART B-LONG ANSWER QUESTIONS** | | | | |
| 1 | Explain any four basic relationships between pixels. | Understand | The learner to **Recall** the relationship between pixels and **Understand** the Neighbor of a pixels | CO 1 |
| 2 | Demonstrate the components of digital image processing system and explain each block. | Understand | The learner to **Recall** the image coordinates and **Understand** elements of image processing system. | CO 1 |
| 3 | Define digital image. Discuss how digital images are represented with neat diagrams. | Understand | The learner to **Recall** the representation of digital image and **Understand** the processing of digital image. | CO 1 |
| 4 | Discuss sampling and quantization With necessary diagrams. | Understand | The learner to **Recall** the sampling and quantization techniques and **Understand** the conversion of analog image in to digital image. | CO 1 |
| 5 | Discuss the effect of increasing sampling frequency and quantization levels on image | Understand | The learner to **Recall** the sampling and quantization and **Understand** effect of increasing the sampling frequency and greylevels | CO 1 |
| 6 | List and explain applications of image processing | Understand | The learner to **Recall** the basics of image processing and **Understand** the applications based on electromagnetic spectrum | CO 1 |

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| 7 | Define spatial resolutions? Discuss the effect on the image by reducing it. | Understand | The learner to **Recall** the sampling and quantization **Understand** effect of increasing the sampling frequency. | CO 1 |
| 8 | Interpret the concept of non-uniform sampling and quantization. | Understand | The learner to **Recall** quantization and **Understand** the non uniform quantization. | CO 1 |
| 9 | Discuss the most commonly used distance measures in image processing | Understand | The learner to **Recall** digital image, neighbours and **Understand** various distance measures. | CO 1 |
| 10 | The image refers to a two dimensional light intensity function. Discuss in detail. | Understand | The learner to **Recall** the Gray levels and **Understand** the Gray level to binary conversion. | CO 1 |
| 11 | Discuss the image acquisition using a single sensor, sensor strips and sensor arrays. | Understand | The learner to **Recall** image acquisition and **Understand** various sensors | CO 1 |
| 12 | What is restoration models? Explain in detail and Write its properties. | Understand | The learner to **Recall** nthe image transforms and **Understand** basis function of transform. | CO 2 |
| 13 | Explain about intensity Transform and Write its properties . | Understand | The learner to **Recall** the image transforms and **Understand** basis function of intensity transformation | CO 2 |
| 14 | Explain the following two image operations of i) spatial operations ii) stastical operations | Understand | The learner to **Recall** the discrete fourier transform and **Understand** the properties of 2D DFT | CO 2 |
| 15 | Explain the following mathematical operations on digital images i) Array versus Matrix operations ii) Linear versus Nonlinear Operations | Understand | The learner to **Recall** the fundamental concept of images and **Understand** various mathematical operations on digital image. | CO 1 |
| 16 | Describe the need of image transform? List out various transform used in image processing. | Understand | The learner to **Recall** the image transforms and **Understand** different transforms. | CO 2 |

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| 17 | Explain the following terms: (i) Adjacency (ii) Connectivity (iii) Regions (iv) Boundaries | Understand | The learner to **Recall** the concept of pixels and **Understand** the relationship between pixels | CO 1 |
| 18 | State the following two properties of image operations i) Translation ii) Rotation | Understand | The learner to **Recall** the discrete fourier transform and **Understand** the properties of image operations | CO 2 |
| 19 | Derive the basis function for restoration model | Understand | The learner to **Recall** the image transform and **Understand** the basis function of restoration model. | CO2 |
| 20 | Prepare the 4,8-,m-adjacancy based on the lengths of shortest 4,8,m-paths between pixels with suitable examples. | Understand | The learner to **Recall** the concept of pixels and **Understand** the relationship between pixels | CO 1 |
| **PART C-SHORT ANSWER QUESTIONS** | | | | |
| 1 | Define digital image processing | Remember | —— | CO 1 |
| 2 | Write any two origins of image processing? | Remember | —— | CO 1 |
| 3 | Mention different types of digital images. | Remember | —- | CO 1 |
| 4 | Mention different bands in electromagnetic spectrum. | Remember | —- | CO 1 |
| 5 | Which step is the objective of digital image processing? | Remember | —- | CO 1 |
| 6 | Explain the hardware components of an image processing. | Understand | The learner to **Recall** the digital image and **Understand** the components of an image processing | CO 1 |
| 7 | What is meant by Image Pixel? | Remember | —- | CO 1 |
| 8 | What are the different fields in which Digital Image Processing is used? | Remember | —- | CO 1 |
| 9 | What is the need of image processing? | Remember | —- | CO 1 |

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| 10 | Explain connectivity and path in relationship between pixels. | Understand | The learner to **Recall** the digital image and **Understand** the relationship between pixels | CO 1 |
| 11 | Discuss about 4,8,diagonal neighbours. | Understand | The learner to **Recall** the relationship between pixels and **Understand** the image connectivity | CO 1 |
| 12 | Explain region and boundary in the image. | Understand | The learner to **Recall** the image connectivity and **Understand** the region and boundary of an image | CO 1 |
| 13 | Write the changes in sizes of different resolution images? | Remember | —— | CO 1 |
| 14 | What is meant by illumination and reflectance in image function? | Remember | —— | CO 1 |
| 15 | What are the applications of image processing? | Remember | —- | CO 1 |
| 16 | List the different components in a simple Image formation model. | Remember | —— | CO 1 |
| 17 | Explain about sampling role in digitization process. | Understand | The learner to **Recall** the sampling theorem and **Understand** the digitization process | CO 1 |
| 18 | Explain about quantization in digitization process. | Understand | The learner to **Recall** the sampling and quantization techniques and **Understand** the digitizing amplitude values | CO 1 |
| 19 | List the basic steps involved in image processing? | Remember | — | CO 1 |
| 20 | Define distance measure and Give the different distance measures. | Remember | —— | CO 1 |

| MODULE II | | | | |
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| IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN | | | | |
| PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS | | | | |
| 1 | Obtain histogram equalization for the following image segment of size 5 X 5? Write the inference on image segment before and after equalization<br>20 20 20 18 16<br>15 15 16 18 15<br>15 15 19 15 17<br>16 17 19 18 16<br>20 18 17 20 15 | Apply | The learner to **Recall** the operation of pixels and gray levels and **Understand** the histogram equalization and **apply** image segment of size 5 X 5 and calculate the result with original image | CO 3 |
| 2 | Apply the steps involved in histogram equalization on the image.<br>$\begin{bmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{bmatrix}$ | Apply | The learner to **Recall** the operation of pixels and gray levels and **Understand** the histogram equalization and apply image segment of size 5 X 5 and analyze the result with original image | CO 3 |
| 3 | Obtain histogram equalization for the following image segment of size 5 X 5? Write the inference on image segment before and after equalization<br>200 200 200 180 240<br>180 180 180 180 190<br>190 190 190 190 180<br>190 200 220 220 240<br>230 180 190 210 230 | Apply | The learner to **Recall** the operation of pixels and gray levels and **Understand** the histogram equalization and **apply** image segment of size 5 X 5 | CO 3 |

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| 4 | A 4 × 4, 4bits/pixel image f(m, n) is passed through point-wise intensity transformation $g(m, n) = \text{round}(10\sqrt{f(m,n)})$. Determine the output image g(m,n) if f (m,n) is given by $\begin{bmatrix} 12 & 8 & 4 & 9 \\ 10 & 5 & 3 & 6 \\ 8 & 12 & 9 & 13 \\ 4 & 12 & 9 & 10 \end{bmatrix}$ | Apply | The learner to **Recall** point processing and **Understand** the round operation and **apply** on image. | CO 3 |
| 5 | Given an image of size 3 × 3 as $f(x, y) = \begin{bmatrix} 128 & 212 & 255 \\ 54 & 62 & 124 \\ 140 & 152 & 156 \end{bmatrix}$ $f(m, n) =$ . Determine the output image $g(m, n) = [c \log_{10}(1 + f(m, n))]$ using logarithmic transformation by choosing c as i. c = 1 and ii $c = \frac{L}{\log_{10}(1+L)}$ | Apply | The learner to **Recall** point processing and **Understand** the log transformation and **apply** on image. | CO 3 |
| 6 | Obtain histogram equalization for the following image segment of size 5 X 5? Write the inference on image segment before and after equalization $g(m, n) = \text{round}(10\sqrt{f(m,n)})$. Determine the output image g(m,n) if f (m,n) is given by $\begin{bmatrix} 12 & 8 & 4 & 9 \\ 10 & 5 & 3 & 6 \\ 8 & 12 & 9 & 13 \\ 4 & 12 & 9 & 10 \end{bmatrix}$ | Apply | The learner to **Recall** the operation of pixels and gray levels and **Understand** the histogram equalization and **apply** image segment of size 5 X 5 and calculate the result with original image | CO 3 |

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| 7 | Compute the bit planes of the given 8 bit image $f(x,y) = \begin{bmatrix} 255 & 138 & 30 \\ 65 & 12 & 201 \\ 183 & 111 & 85 \end{bmatrix}$ | Apply | The learner to **Recall** point processing and **Understand** the round operation and **apply** on image . | CO 3 |
| 8 | Compute the value of the marked pixels if it is smoothened by a 3 × 3 average filter. $\begin{bmatrix} 0 & 1 & 2 & 3 & 2 \\ 5 & 6 & 7 & 8 & 4 \\ 4 & (3) & (2) & (1) & 2 \\ 8 & 7 & 6 & 5 & 3 \\ 1 & 5 & 3 & 7 & 8 \end{bmatrix}$ | Apply | The learner to **Recall** low pass and high pass filters and **Understand** in image processing for image enhancement and **apply** on a segment of image. | CO 3 |
| 9 | If a low pass filter is formed that averages the 4 neighbours of a point (x,y) but excludes point itself. Find the equivalent transfer function in frequency domain. Show that it is low pass filter | Apply | The learner to **Recall** low pass filter and **Understand** the kernel in image processing for image enhancement and **apply** fourier transform for spatial filter. | CO 3 |
| 10 | Discuss on the basics of spatial filtering in image enhancement. | Understand | The learner to **Recall** Image Morphology and prepare algorithms and **Understand** Image Morphology and basic algorithm. | CO 3 |
| **PART B-LONG ANSWER QUESTIONS THINKING** | | | | |
| 1 | Explain in detail about histogram processing. | Understand | The learner to **Recall** the probability of occurrence of gray levels and **Understand** the histogram processing. | CO 3 |
| 2 | With the help of block diagram explain homomorphic filtering approach for image enhancement. | Understand | The learner to **Recall** filtering techniques and **Understand** the homomorphic Filtering | CO 3 |

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| 3 | Describe various types of mean filters for image enhancement. | Understand | The learner to **Recall** filter functions and **Understand** the various types of mean filters. | CO 3 |
| 4 | Demonstrate enhancement of monochrome image by histogram | Understand | The learner to **Recall** the monochrome technique and **Understand** the monochrome image by Histogram | CO 3 |
| 5 | Discuss the procedure involved in Histogram matching. | Understand | The learner to **Recall** the operation of pixels and gray levels and **Understand** the histogram equalization and matching. | CO 3 |
| 6 | Explain the steps in histogram equalization. | Understand | The learner to **Recall** the operation of pixels and gray levels and **Understand** the histogram equalization . | CO 3 |
| 7 | Classify restoration models and list out its applications | Understand | The learner to **Recall** morphology and Binary morphology and **Understand** in image processing for image enhancement | CO 3 |
| 8 | List out the various of gray level transformation used for image enhancement. | Understand | The learner to **Recall** the operation of pixels and gray levels **Understand** the gray level transformation for image enhancement | CO 3 |
| 9 | Classify the types of filters in spatial domain filters of image enhancement. | Understand | The learner to **Recall** Feature selection Techniques and **Understand** butterworth and aussian for image enhancement | CO 3 |
| 10 | Describe Butterworth low pass and Butterworth high pass filters. | Understand | The learner to **Recall** low pass and high pass filters and **Understand** the Butterworth filter . | CO 3 |
| 11 | List the salient features of image histogram. | Understand | —— | CO 3 |
| 12 | Discuss the following spatial enhancement techniques. iii) Spatial averaging. (ii)Median filtering. | Understand | The learner to **Recall** the spatial filters and **Understand** the enhancement techniques. | CO 3 |

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| 13 | Prepare the linear spatial sharpening filtering for image enhancement. | Understand | The learner to **Recall** the spatial filters and **Understand** the linear spatial sharpening filters. | CO 3 |
| 14 | Explain linear spatial smoothing filtering. | Understand | The learner to **Recall** the spatial filters and **Understand** the linear spatial smoothing filters. | CO 3 |
| 15 | Interpret image processing transforms using point processing method for iii) Negative image. ii)Thresholding iii)Log Transformation | Understand | The learner to **Recall** concept of point processing and **Understand** the various techniques for point processing. | CO 3 |
| 16 | Interpret the homomorphic filtering in image enhancement which is related to frequency domain filtering. | Understand | The learner to **Recall** concept of point processing and **Understand** the various techniques for point processing. | CO 3 |
| 17 | Explain smoothing of images in frequency domain using region based segmentation. | Understand | The learner to **Recall**, region based segmentation. **Understand** in smoothing in frequency domain. | CO 3 |
| 18 | What is meant by the Feature extraction and representation? Discuss their role in image enhancement. | Understand | The learner to **Recall** operation of pixels and gray level and **Understand** the concept of feature extraction and the representation. | CO 3 |
| 19 | Sketch perspective plot of an histogram process by smoothing and sharpening function of filter cross section and explain its usefulness in Image enhancement. | Understand | The learner to **Recall** feature image classification and prepare algorithms and **Understand** transfer function for image enhancement. | CO 3 |
| 20 | Explain the following operations: i) Binary morphology ii) Gray-level morphology | Understand | The learner to **Recall** point operations and **Understand** the concept of Gray-level morphology and Binary morphology. | CO 3 |
| **PART C -SHORT ANSWER QUESTIONS** | | | | |

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| 1 | Specify the objective of image enhancement technique. | Remember | —— | CO 3 |
| 2 | Explain the 2 categories of image enhancement. | Remember | —— | CO 3 |
| 3 | What are the edge operations? | Remember | —— | CO 3 |
| 4 | What is morphology processing? | Understand | The learner to **Recall** the mask and **Understand** how the mask is operating on image. | CO 3 |
| 5 | What is contrast stretching? | Remember | —— | CO 3 |
| 6 | What is thresholding? | Remember | —— | CO 3 |
| 7 | What is Binary morphology? | Remember | —— | CO 3 |
| 8 | What is image averaging? Give its application? | Remember | —— | CO 3 |
| 9 | Explain the purpose of image averaging? | Understand | This would require the learner to **Recall** the averaging mask and **Understand** the effect of mask on image. | CO 3 |
| 10 | Give the formula for negative and log transformation. | Remember | —— | CO 3 |
| 11 | What is meant by bit gray level morphology? | Remember | —— | CO 3 |
| 12 | Define histogram. | Remember | —— | CO 3 |
| 13 | Discuss image negatives? | Understand | This would require the learner to **Recall** the image segmentation and **Understand** image negative. | CO 3 |
| 14 | State the first order derivative filter or gradient filter. | Remember | —— | CO 3 |
| 15 | What is a Component Labeling ? | Remember | —— | CO 3 |
| 16 | Explain median filter? | Understand | The learner to **Recall** the image enhancement **Understand** median filter. | CO 3 |
| 17 | What is a smoothing filter? | Remember | —— | CO 3 |
| 18 | What is a sharpening filter? | Remember | —— | CO 3 |

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| 19 | Explain unsharp masking. | Understand | The learner to **Recall** the mask and **Understand** use of unsharp masking on image. | CO 3 |
| 20 | What are the feature selection techniques ? | Remember | —— | CO 3 |
| **MODULE III** | | | | |
| **IMAGE RESTORATION AND FILTERING** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Apply order statistics filter on the selected pixels in the image.<br>1 2 3<br>0 1 2<br>1 4 5 | Apply | The learner to **Recall** filter and **Understand** the various order statistics filters and apply on 3x3 image segment. | CO 4 |
| 2 | Justify the discussion "Morphological algorithms is an effective tool to minimize the salt and pepper noise through simple illustaration. | Apply | The learner to **Recall** salt and pepper noise and **Understand** median filter and **apply** on image segment. | CO 4 |
| 3 | Compute the median value of the marked pixels shown below using 3x3 mask<br>$\begin{bmatrix} 18 & 22 & 33 & 25 & 32 & 24 \\ 34 & (128) & (24) & (172) & (26) & 33 \\ 22 & 19 & 32 & 31 & 28 & 26 \end{bmatrix}$ | Apply | The learner to **Recall** grey level image and **Understand** median filter and **apply** on image segment 3x6 for marked pixels. | CO 4 |
| 4 | Compare image enhancement and image restoration . | Understand | The learner to **Recall** digital image and **Understand** image enhancement and restoration. | CO 4 |

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| 5 | Show effect of mean, geocentric mean, harmonic mean filter for the given marked image. $f(x,y)=\begin{bmatrix}128 & 128 & 128 & 128 & 128\\ 128 & 255 & 128 & 255 & 128\\ 128 & 128 & 255 & 128 & 128\\ 128 & 255 & 128 & 0 & 128\\ 128 & 128 & 128 & 128 & 128\end{bmatrix}$ | Apply | The learner to **Recall** grey level image and **Understand** mean, geomentric, harmonic filter and **apply** on image segment 5x5. | CO 4 |
| **CIE-II** | | | | |
| 6 | Analyse effect of max, min filter for the given image and interpret the results. image. $f(x,y)=\begin{bmatrix}30 & 10 & 20\\ 10 & 250 & 25\\ 20 & 25 & 30\end{bmatrix}$ | Apply | The learner to **Recall** grey level image and **Understand** min, max filters and **apply** on image segment 3x3 and analyze the resulting images . | CO 4 |
| 7 | Describe image segmentation technique for image restoration and write active contour models in details. | Understand | The learner to **Recall** the image segmentation and **Understand** transfer function of constrained least square function. | CO 4 |
| 8 | Derive transfer function of regional descriptors approach for image restoration | Understand | The learner to **Recall** the filter and **Understand** transfer function of weiner filter | CO 4 |
| 9 | Summarize the drawback image representation and analysis with suitable examples | Understand | The learner to **Recall** the filter and **Understand** image representation and analysis with suitable examples | CO 4 |
| **PART B-LONG ANSWER QUESTIONS** | | | | |
| 1 | Illustrate the different causes of image degradation | Understand | The learner to **Recall** the noise sources and **Understand** the causes for image degradation. | CO6 |
| 2 | Summarize the power density function of uniform noise, salt & pepper noise and Gaussian noise and sketch it. | Understand | The learner to **Recall** the noise sources and **Understand** the power density function of noise. | CO6 |

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| 3 | Explain mean and geometric mean filter for image restoration. | Understand | The learner to **Recall** filter and **Understand** the transfer function of mean and geometric mean filer. | CO4 |
| 4 | Explain erosion and dilation for image restoration. | Understand | The learner to **Recall** filter and **Understand** the transfer function of statistical image. | CO6 |
| 5 | Demonstrate the most commonly used noise probability density functions in image processing applications and explain with its plot. | Understand | The learner to **Recall** the noise sources and **Understand** the most commonly used noise sources . | CO6 |
| 6 | Explain the process of restoration in the presence of noise only using spatial filters for various mean filters? | Understand | The learner to **Recall** filter, noise and **Understand** image restoration by elastic deformation. | CO6 |
| 7 | Discuss the three principal ways to estimate the degradation function for use in image restoration and explain it. | Understand | The learner to **Recall** image restoration and **Understand** image degradation function. | CO6 |
| 8 | Explain regid body visualization used for restoring images | Understand | The learner to **Recall** visualization, noise and **Understand** image restoration by order statistics filters. | CO6 |
| 9 | Explain how degradation is estimated using i)observation ii)mathematical modeling | Understand | The learner to **Recall** image restoration and **Understand** estimation of image degradation function. | CO6 |
| 10 | Summarize Image degradation and restoration process? Explain various Noise filters in detail. | Understand | The learner to **Recall** image restoration and **Understand** image degradation function. | CO6 |
| **CIE-II** | | | | |
| 11 | Explain alpha trimmed filters for image restoration. | Understand | The learner to **Recall** image restoration and **Understand** image degradation function. | CO6 |

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| 12 | Discuss inverse filtering for image restoration. | Understand | The learner to **Recall** the filter and **Understand** transfer function of inverse filtering. | CO6 |
| 13 | Demonstrate the model for image degradation. | Understand | The learner to **Recall** the image restoration and **Understand** image degradation model. | CO6 |
| 14 | Discuss constrained least square filtering method for restoration in details | Understand | The learner to **Recall** the filter and **Understand** transfer function of constrained least square function. | CO 4 |
| 15 | Discuss about exponential, ayleigh noise and how it can be removed. | Understand | The learner to **Recall** the noise models and **Understand** the removal of noise. | CO 4 |
| 16 | Describe inverse filtering for removal of blur caused by any motion and describe how it restore the image | Understand | The learner to **Recall** concept of blur **Understand** the blur removal by inverse filtering. | CO 4 |
| 17 | Explain the following filtering techniques (1) Noise models by mean of filter (2) Constrained models by mean of filter (3) Homomorphic filter | Understand | The learner to **Recall** spatial filter for restoration and **Understand** the concept of various filters. | CO 4 |
| 18 | Summarize minimum mean square error filtering for image restoration. | Understand | The learner to **Recall** the filter and **Understand** transfer function of minimum mean square filter function. | CO 4 |
| 19 | Discuss about erlang noise and how it can be removed. | Understand | The learner to **Recall** the noise sources and **Understand** the power density function of noise. | CO 4 |
| 20 | What is Image restoration? Draw and explain the basic block diagram of the restoration process. Give two areas where restoration process can be applied | Understand | The learner to **Recall** image restoration and **Understand** image degradation function. | CO 4 |

| PART C- SHORT ANSWER QUESTIONS | | | | |
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| 1 | What is meant by Image Restoration? | Remember | ——- | CO 4 |
| 2 | How a degradation process is modeled? | Remember | ——- | CO 4 |
| 3 | Differentiate image enhancement and image restoration | Remember | ——- | CO 4 |
| 4 | What are the two methods of algebraic image restoration approach? | Remember | ——- | CO 4 |
| 5 | What is inverse filtering? | Remember | ——- | CO 4 |
| 6 | What is pseudo inverse filter? | Remember | ——- | CO 4 |
| 7 | Explain the causes of degradation in an image. | Understand | The learner to **Recall** image restoration and **Understand** causes for image degradation. | CO 4 |
| 8 | What are the two methods of algebraic image restoration approach? | Remember | ——- | CO 4 |
| 9 | What is dynamic (or) Adaptive thresholding? | Remember | ——- | CO 4 |
| 10 | Explore the restoration is called unconstrained restoration? | Remember | ——- | CO 4 |
| CIE-II | | | | |
| 11 | Write notes on Least square error filter | Remember | ——- | CO 4 |
| 12 | Describe constrained least square filtering for image restoration and derive its transfer function. | Remember | ——- | CO 4 |
| 13 | What is inverse filtering? | Remember | ——- | CO 4 |
| 14 | What is pseudo inverse filter? | Remember | ——- | CO 4 |
| 15 | What is a adaptive median filter? | Remember | ——- | CO 4 |
| 16 | Define arithmetic mean filter . | Remember | ——- | CO 4 |
| 17 | Define geometric mean filter . | Remember | ——- | CO 4 |
| 18 | Explain spatial filtering. | Remember | ——- | CO 4 |

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| 19 | What is a median filter? | Remember | ——- | CO 4 |
| 20 | What is harmonic mean filter? | Remember | ——- | CO 4 |
| **MODULE IV** | | | | |
| **COLOR IMAGE PROCESSING** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Deonstrate the pseudo color image processing with neat diagram. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** the magnitude and direction of the gradient of the pixel. | CO 5 |
| 2 | Diffrentiate smoothing and sharpening in color segmentation with suitable examples. | Understand | The learner to **Recall** image segmentation and **Understand** the image segmentation | CO 5 |
| 3 | List the Color models and explain each model with suitable example. | Understand | The learner to **Recall** gradient operator and **Understand** the medical image segmentation. | CO 5 |
| 4 | Demonstrate the basics of full-color image processing in color image processing. | Understand | The learner to **Recall** gradient operator and **Understand** the statistical image representation. | CO 5 |
| 5 | Summarize the color transformations with examples in color image processing. | Apply | The learner to **Recall** the image into segments of its constituents and **Understand** the information contained and **apply** the statistical image representation to segment the image | CO 5 |
| 6 | source rigid body visualization from any method of 2D or 3D display A={a1,a2,a3,a4,a5} with probabilities P(a1)=0.2, P(a2) = 0.4 , P(a3) = 0.2 , P(a4) = 0.1 and P(a5) = 0.1.Find Huffman code for this source? Find the rigid body visualization code and its method of 2D or 3D display | Apply | The learner to **Recall** average method of 2D and 3D display **Understand** the encoding process then **apply** method of 2D or 3D display for given source and find method of 2D or 3D display | CO 5 |

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| 7 | Perform Huffman algorithm for the following intensity distribution, for a 64 x 64 image. Obtain the coding efficiency and compare with that of uniform length code. R0 = 1008, r1 = 320 , r2 = 456 , r3 = 686 ,r4 = 803 .r5 = 105 ,r6 =417 ,r7 = 301 | Apply | The learner to **Recall** the code efficiency and **Understand** the intensity distribution and **apply** Huffman algorithm and compare with that of uniform length code. | CO 5 |
| 8 | A source emits letters from asn alphabet A={a1,a2,a3,a4,a5} with probabilities P(a1)=0.3, P(a2) = 0.4 , P(a3) = 0.15 , P(a4) = 0.05 and P(a5) = 0.1.Find for this source? Find the average length of the code and its redundancy. | Apply | The learner to **Recall** the codeword and **Understand** the procedure for uffman coding and **apply** it to find the average length of the code and its redundancy. | CO 5 |
| 9 | Obtain Huffman coding for the source symbols S={S0 ,S1, S2, S3,S4} and the corresponding probabilities P= {0.4 ,0.2,0.2,0.1,0.1}. | Understand | The learner to **Recall** the encoding techniques and **Understand** the uffman coding for source symbols and probabilities. | CO 5 |
| 10 | Explain the color segmentation with neat diagram. | Understand | The learner to **Recall** binary image representation and **Understand** the structuring element and **apply** the input image is opened and closed by structuring element B. | CO 5 |
| **PART B-LONG ANSWER QUESTIONS** | | | | |
| 1 | What is noise? Explain how noise can be generated in color images. | | The learner to **Recall** binary image representation and **Understand** the structuring element and **apply** the input image is opened and closed by structuring element B. | CO 5 |

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| 2 | Explain color image compression techniques with suitable exaples. | | The learner to **Recall** binary image representation and **Understand** the structuring element and **apply** the input image is opened and closed by structuring element B. | CO 5 |
| 3 | Discuss the Wavelets and multi resolution processing techniques in color image processing. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for global thresholding. | CO 5 |
| 4 | Demonstrate the Image pyramids with neat diagrams. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for region based segmentation. | CO5 |
| 5 | Illustrate the sub band coding in color image processing. | Understand | The learner to **Recall** the Image visualization and **Understand** smaller entities for Image visualization. | CO5 |
| 6 | Explain the haar transform. Justify how it is useful in color image processing. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** the closing operation in image morphology segmentation. | CO 5 |
| 7 | Explain the multi resolution expansions in color image processing. | Understand | The learner to **Recall** the concept of multi resolution and **Understand** how it will be used in color image processing. | CO 5 |
| 8 | Demonstrate the wavelet transforms in one dimension | Understand | The learner to **Recall** what is wavelet and **Understand** how it is used in one dimension. | CO 5 |
| 9 | Explain fast wavelet transform in color image processing | Understand | The learner to **Recall** what is fast wavelet transform and **Understand** how it is used in color image processing. | CO 5 |

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| 10 | Demonstrate the wavelet transforms in two dimension | Understand | The learner to **Recall** the image into segments and **Understand** in to morphing for dilation and erosion. | CO 5 |
| 11 | List the wavelet packets with neat diagrams. | Understand | The learner to **Recall** the image into segments and **Understand** the thresholding process. | CO 5 |
| 12 | Draw and explain image compression models in color image processing. | Understand | The learner to **Recall** the image into segments and **Understand** the boundary characteristics. | CO 5 |
| 13 | Derive the error-free (lossless) compression with example. | Understand | The learner to **Recall** the image into segments and **Understand** the image segmentation. | CO 5 |
| 14 | Demonstrate the fundamentals of wavelet packets with neat diagrams | Understand | The learner to **Recall** the image into segments and **Understand** the Hough transform for edge linking image segmentation. | CO 5 |
| 15 | List the types of noises in color image processing. i) Thinning ii) Thickening | Understand | The learner to **Recall** the image into segments and **Understand** the edge linking in image segmentation. | CO 5 |
| 16 | Explain the fundamentals of color image processing techniques. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for region splitting and merging based on segmentation. | CO 5 |
| 17 | Compare the Wavelets and multi resolution processing | Understand | The learner to **Recall** the image into segments and **Understand** the of Hit-or-Miss morphological transformation | CO 5 |
| 18 | Convert the RGB pixel (R,G,B) = (20, 40, 60) into (r,g,b), (r,g,I), (H,S,I), (H,S,V ), (Y,U,V ), and (Y,Cb,Cr), respectively. | Understand | The learner to **Recall** the image into segments and **Understand** the of Hit-or-Miss morphological transformation | CO 5 |

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| 19 | How many different 512 × 512 color (24-bit) images can be constructed? | Understand | The learner to **Recall** the image into segments and **Understand** the of Hit-or-Miss morphological transformation | CO 5 |
| 20 | An RGB image is converted into a gray-scale image so that the cyan color is enhanced. What are the weight factors for R, G, and B, respectively? | Understand | The learner to **Recall** the image into segments and **Understand** the of Hit-or-Miss morphological transformation. | CO 5 |
| **PART C-SHORT ANSWER QUESTIONS** | | | | |
| 1 | What is segmentation? | Remember | ——- | CO 5 |
| 2 | Write the applications of segmentation | Remember | ——- | CO 5 |
| 3 | What are the three types of discontinuity in digital image? | Remember | ——- | CO 5 |
| 4 | How the derivatives are obtained in color transformations,? | Remember | ——- | CO 5 |
| 5 | What are the Image pyramids? | Remember | ——- | CO 5 |
| 6 | Give the properties of coding. | Remember | ——- | CO 5 |
| 7 | Define error in image. | Remember | ——- | CO 5 |
| 8 | What is resolution in image? | Remember | ——- | CO 5 |
| 9 | What are the disadvantages of Laplacian operator? | Remember | ——- | CO 5 |
| 10 | What is lossy compression? | Remember | ——- | CO 5 |
| 11 | What is wavelet in image? | Remember | ——- | CO 5 |
| 12 | What is full-color image processing? | Remember | ——- | CO 5 |
| 13 | What is image pyramids? | Remember | ——- | CO 5 |
| 14 | What is image smoothing? | Remember | ——- | CO 5 |
| 15 | What are the advantages of smoothing? | Remember | ——- | CO 5 |
| 16 | What are the disadvantages of smoothing? | Remember | ——- | CO 5 |
| 17 | Define sharpening?. | Remember | ——- | CO 5 |
| 18 | What are the advantages of sharpening? | Remember | —— | CO 5 |
| 19 | Define pseudo color image. | Remember | ——- | CO 5 |

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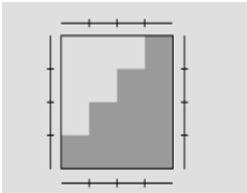
| 20 | Give the properties of pseudo color image processing. | Remember | ——- | CO 5 |
| **MODULE V** | | | | |
| **SYSTEM DESIGN TECHNIQUES** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Consider an image segment of size 5x5 and explain the magnitude and direction of the gradient of the pixel. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** the magnitude and direction of the gradient of the pixel. | CO 6 |
| 2 | Explain image segmentation for detecting pixel- based ,edge- based ,region-based | Understand | The learner to **Recall** image segmentation and **Understand** the image segmentation | CO 6 |
| 3 | Illustrate medical image segmentation for detecting pixel- based ,edge- based ,region-based | Understand | The learner to **Recall** gradient operator and **Understand** the medical image segmentation. | CO 6 |
| 4 | Explain statistical image representation for detecting edges and its response | Understand | The learner to **Recall** gradient operator and **Understand** the statistical image representation. | CO 5 |
| 5 | Apply statistical image representation to segment the below image.  | Apply | The learner to **Recall** the image into segments of its constituents and **Understand** the information contained and **apply** the statistical image representation to segment the image | CO 5 |
| 6 | Show that a invariant feature transformation separable while the whole-image features object is need to be seperable. | Understand | The learner to **Recall** separable property and **Understand** the invariant feature transformation. | CO 5 |

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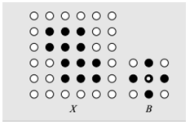
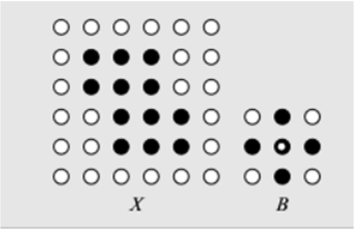
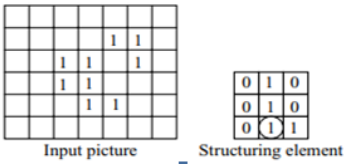
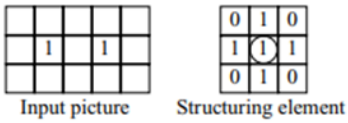
| 7 | A binary image and structuring element as shown below<br>i) Calculate $X^C$<br>ii) Calculate dilation of X by structuring element B<br>  <br> | Apply | The learner to **Recall** segment of an image and **Understand** the structuring element of an image and **apply** to calculate XC and dilation of X by structuring element B. | CO 5 |
| 8 | A binary image and structuring element as shown below<br>i) Calculate complement of the input image is taken which is eroded by the structuring element B<br>ii) Calculate the input image is eroded by structuring element B<br>  <br> | Apply | The learner to **Recall** the image into segments of its constituents and **Understand** the structuring element and **apply** the input image is eroded by structuring element B | CO 5 |
| 9 | The input picture and structuring elements are shown below. Perform the erosion and dilation of the given below table.<br>  <br> | Apply | The learner to **Recall** binary image representation and **Understand** the structuring element and **apply** the input image is eroded and dilation by structuring element B. | CO 5 |
| 10 | The input picture and structuring elements are shown below. Perform the opening and closing of the below input picture.<br>  <br> | Apply | The learner to **Recall** binary image representation and **Understand** the structuring element and **apply** the input image is opened and closed by structuring element B. | CO 5 |
| **PART B-LONG ANSWER QUESTIONS** | | | | |

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| 1 | How do you perform edge detection? Give suitable algorithm and discuss how the edge points are linked. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for region based segmentation. | CO 5 |
| 2 | Discuss how region Growing approach are used for image 3segmentation. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for Edge linking based segmentation. | CO 5 |
| 3 | Discuss how region splitting and merging approach are used for image segmentation. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for global thresholding. | CO 5 |
| 4 | What is edge detection? Describe in detail about the types of edge detection operations. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for region based segmentation. | CO5 |
| 5 | Illustrate the hit-or-miss transformation in image design techniques.. | Understand | The learner to **Recall** the Image visualization and **Understand** smaller entities for Image visualization. | CO5 |
| 6 | Explain the detection of discontinuities with examples. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** the closing operation in image morphology segmentation. | CO 5 |
| 7 | What do you Understand by dilation and erosion in morphological operation? Explain in detail. | Remember | ——- | CO 5 |
| 8 | How do you link edge pixels through global processing? | Remember | ——- | CO 5 |
| 9 | Explain region based segmentation and region growing with an example. | Remember | ——- | CO 5 |

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| 10 | Discuss image segmentation based on various thresholding techniques. | Understand | The learner to **Recall** the image into segments and **Understand** in to morphing for dilation and erosion. | CO 5 |
| 11 | Describe gradient operators based edge detection method with necessary masks and equations. | Understand | The learner to **Recall** the image into segments and **Understand** the thresholding process. | CO 5 |
| 12 | Explain gradient operators based edge detection method with necessary masks and equations. | Understand | The learner to **Recall** the image into segments and **Understand** the boundary characteristics. | CO 5 |
| 13 | Explain edge linking using Hough transform. | Understand | The learner to **Recall** the image into segments and **Understand** the image segmentation. | CO 5 |
| 14 | Explain the following morphological algorithms i) Boundary extraction ii) Hole filling. | Understand | The learner to **Recall** the image into segments and **Understand** the Hough transform for edge linking image segmentation. | CO 5 |
| 15 | Explain the following morphological algorithms. i) Thinning ii) Thickening | Understand | The learner to **Recall** the image into segments and **Understand** the edge linking in image segmentation. | CO 5 |
| 16 | With necessary figures, explain the opening and closing operations. | Understand | The learner to **Recall** the image into segments of its constituents and **Understand** smaller entities for region splitting and merging based on segmentation. | CO 5 |
| 17 | How can you control over segmentation problem? Explain it. | Understand | The learner to **Recall** the image into segments and **Understand** the of Hit-or-Miss morphological transformation | CO 5 |
| 18 | Explain the detection of isolated points in an image. | Understand | The learner to **Recall** the image into segments and **Understand** in to morphing image processing | CO 5 |

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| 19 | Explain about morphological hit-or-miss transform. | Understand | The learner to **Recall** the image into segments and **Understand** in to morphing for dilation and erosion of image processing. | CO 5 |
| 20 | Explain watershed transformation and discuss about its advantages and disadvantages. | Understand | The learner to **Recall** the image into segments and **Understand** the of Hit-or-Miss morphological transformation. | CO 5 |
| **PART C-SHORT ANSWER QUESTIONS** | | | | |
| 1 | What is syatem design in an image? | Remember | ——- | CO 6 |
| 2 | Define the Preliminaries. | Remember | ——- | CO 6 |
| 3 | What are the types of Preliminaries? | Remember | ——- | CO 6 |
| 4 | What are the advantages of Preliminaries? | Remember | ——- | CO 6 |
| 5 | What dilation and erosion of an images. | Remember | ——- | CO 6 |
| 6 | Define transformation. | Remember | ——- | CO 6 |
| 7 | What is Image representation and analysis? | Remember | ——- | CO 6 |
| 8 | What is morphological image? | Remember | ——- | CO 6 |
| 9 | State the feature of morphological algorithms. | Remember | ——- | CO 6 |
| 10 | What is segmentation? | Remember | ——- | CO 6 |
| 11 | What are the operations performed by segmentation? | Remember | ——- | CO 6 |
| 12 | What is edge linking? | Remember | ——- | CO 6 |
| 13 | List out the advantages of segmentation? | Remember | ——- | CO 6 |
| 14 | What is boundary detection? | Remember | ——- | CO 6 |
| 15 | What are the basic steps in boundary detection? | Remember | ——- | CO 6 |
| 16 | What is thresholding? | Remember | ——- | CO 6 |
| 17 | What is region-based segmentation? | Remember | ——- | CO 6 |

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| 18 | Explain the opening and closing. | Understand | The learner to **Recall** the Virtual Reality and prepare the relative algorithms and **Understand** to image intensity levels for feature based registration. | CO 6 |
| 19 | List the advantages of opening and closing. | Remember | ——- | CO 6 |
| 20 | Prepare the importance of syatem design techniques. | Remember | —- | CO 6 |

**Course Coordinator:** **HOD CSIT**
**Ms.B Lakshmi Prasanna , Assistant Professor**