Course Code: 23EC0433 **R23**

SIDDARTH INSTITUTE OF ENGINEERING AND TECHNOLOGY: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583
QUESTION BANK (DESCRIPTIVE)

Subject with Code: DIGITAL IMAGE PROCESSING (23EC0433)

Course & Branch: B.Tech. – ECE **Year & Sem:** III-B.Tech.& II-Sem. **Regulation:** R23

UNIT – I
INTRODUCTION
PART-A (2 MARKS)

1	a	Define Pixel and Digital image?	[L1][CO1]	[2M]
	b	List out the applications of digital image processing?	[L1][CO1]	[2M]
	c	What are the classification of digital images and image types?	[L1][CO1]	[2M]
	d	Discuss the importance of phase in image transforms?	[L2][CO1]	[2M]
	e	Compare different image transforms.	[L2][CO1]	[2M]

PART-B (10 MARKS)

2	a)	State the purpose of the image processing. Explain the fundamental steps in digital image processing which can be applied to images.	[L1][CO1]	[5M]
	b)	Explain about the components of an image processing system with neat diagram?	[L2][CO1]	[5M]
3		Discuss the three principal sensor arrangements used to transform illumination energy into digital images.	[L2][CO1]	[10M]
4	a)	Discuss the method of image sensing and acquisition along with suitable diagrams.	[L2][CO1]	[5M]
	b)	Explain about image sampling and quantization process with proper steps.	[L2][CO1]	[5M]
5	a)	Discuss the method for representation of a digital image.	[L2][CO1]	[5M]
	b)	Calculate the number of bits required to store a digitized image if image sizes are 8×8, 32×32 for 8-bit pixel depth.	[L3][CO1]	[5M]
6	a)	Explain about the basic pixel relationships and distance measures between pixels in a digital image.	[L2][CO1]	[5M]
	b)	Let V = {1}, Compute the 4-adjacency, 8-adjacency and different paths between two pixels (1,1) and (3,3) for the center pixel in the given image. $A = \begin{matrix} 1 & 4 & 7 \\ 2 & 1 & 1 \\ 3 & 1 & 9 \end{matrix}$	[L3][CO1]	[5M]
7	a)	Summarize the following mathematical operations on digital images with relevant expressions and diagrams. a) Arithmetic operations b) Linear versus Nonlinear Operations c)Array & Matrix operations d) Set & Logical operations	[L2][CO1]	[5M]
	b)	List out the properties of 2D – Discrete Fourier Transform. Prove the Separable and Periodicity property with suitable expressions.	[L1][CO1]	[5M]
8	a)	Discuss the need of Image Transform and Define 1D and 2D – Discrete Fourier Transform with equations .	[L2][CO1]	[5M]
	b)	Deduce the basis function of 2D – Discrete Fourier Transform for N = 4.	[L4][CO1]	[5M]
9	a)	Deduce the basis matrix of Walsh Transform matrix for N = 4.	[L4][CO1]	[5M]
	b)	Evaluate Hadamard transform for the given image $f(x,y) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	[L3][CO1]	[5M]

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10	a)	Compute Haar transform basis for N=2.	[L3][CO1]	[5M]
	b)	Explain in brief about Hoteling (KL) and slant transform used in digital image processing.	[L2] [CO1]	[5M]
11	a)	Compute 2D – Discrete Cosine Transform for N=4.	[L3][CO1]	[5M]
	b)	Find the Singular Value Decomposition (SVD) of matrix A= $\begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}$	[L3][CO1]	[5M]

UNIT –II
INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING
PART-A (2 MARKS)

1.	(a)	Define image enhancement?	[L1][CO2]	[2M]
	(b)	What are the drawbacks of histogram equalization?	[L1][CO2]	[2M]
	(c)	What is a spatial filter mask (kernel)?	[L1][CO2]	[2M]
	(d)	List the advantages of spatial domain filtering.	[L2][CO2]	[2M]
	(e)	Differentiate between smoothing and sharpening filters.	[L1][CO2]	[2M]

PART-B (10 MARKS)

2.	(a)	Explain the concepts of image negative and log transformation with suitable expressions.	[L2][CO2]	[5M]
	(b)	Describe power-law (gamma) transformation and discuss its effect on image contrast.	[L1][CO2]	[5M]
3.	(a)	Explain about Piecewise-linear transformation functions.	[L2][CO2]	[5M]
	(b)	Define histogram and draw the histogram for four basic image types.	[L2][CO2]	[5M]
4.		With suitable examples, Explain the histogram Processing and Histogram equalization.	[L2][CO2]	[10M]
5.	(a)	Explain the fundamentals of spatial filtering with the steps involved in applying a linear filter.	[L2][CO2]	[5M]
	(b)	Discuss about fundamental properties of convolution and correlation.	[L1][CO2]	[5M]
6.		Illustrate the smoothing spatial filters along with required expressions.	[L2][CO3]	[10M]
7.		Illustrate the sharpening spatial filters along with required expressions.	[L2][CO3]	[10M]
8.	(a)	Explain unsharp masking and high-boost filtering with a simple illustration.	[L2][CO3]	[5M]
	(b)	Describe the process of combining spatial enhancement methods for improved image quality.	[L2][CO3]	[5M]
9.	(a)	Compare and contrast spatial domain filtering and frequency domain filtering based on performance and applications.	[L4][CO3]	[5M]
	(b)	Explain the basics steps involved for filtering in frequency domain with neat diagram.	[L2][CO3]	[5M]
10.	(a)	Discuss the Image Smoothing techniques in the frequency domain.	[L2][CO3]	[5M]
	(b)	Discuss the Image sharpening techniques in the frequency domain.	[L2][CO3]	[5M]
11.	(a)	Summarize the steps involved in homomorphic filtering with a neat block diagram.	[L1][CO3]	[5M]
	(b)	Describe about selective filtering.	[L2][CO3]	[5M]

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UNIT –III
IMAGE RESTORATION AND RECONSTRUCTION
PART-A (2 MARKS)

1.	**(a)**	Define Image restoration.	**[L1][CO4]**	**[2M]**
	(b)	Give the types of noise models.	**[L1][CO4]**	**[2M]**
	(c)	Draw the probability density function for Gaussian Noise.	**[L1][CO4]**	**[2M]**
	(d)	Give the expression of error measure and definition.	**[L1][CO4]**	**[2M]**
	(e)	What is the difference between restoration and enhancement?	**[L1][CO4]**	**[2M]**

PART-B (10 MARKS)

2.	**(a)**	Sketch a model of the Image degradation and restoration process and give the brief explanation.	**[L3][CO4]**	**[5M]**
	(b)	Discuss the spatial and frequency properties of Noise.	**[L2][CO4]**	**[5M]**
3.		Explain the different Noise models with clear expressions.	**[L2][CO4]**	**[10M]**
4.	**(a)**	Illustrate the different Mean filters for noise reduction capabilities of the spatial filters.	**[L2][CO4]**	**[5M]**
	(b)	Describe about Median filter and min and max filters with their equation.	**[L2][CO4]**	**[5M]**
5.	**(a)**	Give the detailed explanation of the mid point filter with equation.	**[L2][CO4]**	**[5M]**
	(b)	Discuss briefly about the adaptive median filtering with algorithm.	**[L1][CO4]**	**[5M]**
6.		What is periodic noise in images? Explain the method of periodic noise reduction using frequency domain filtering.	**[L2][CO4]**	**[10M]**
7.	**(a)**	Determine the linear degradations in image restoration.	**[L3][CO4]**	**[5M]**
	(b)	Evaluate position invariant degradations in image restoration.	**[L4][CO4]**	**[5M]**
8.	**(a)**	Demonstrate the three principal ways to estimate the degradation function for use in image restoration.	**[L2][CO4]**	**[5M]**
	(b)	Derive the mathematical model from the basic principles to estimate the degradation.	**[L3][CO4]**	**[5M]**
9.	**(a)**	Compute the simplest approach inverse filtering for image restoration.	**[L3][CO4]**	**[5M]**
	(b)	Explain the use of Wiener filtering in Image restoration.	**[L2][CO4]**	**[5M]**
10.		Discuss about Constrained Least Square restoration of a digital image in detail	**[L2][CO4]**	**[10M]**
11.	**(a)**	Explain the Geometric Mean Filter used for image restoration. Discuss its advantages and limitations.	**[L2][CO4]**	**[5M]**
	(b)	Summarize the four generations of CT scanners for image reconstruction from projections.	**[L2][CO4]**	**[5M]**

UNIT-IV
IMAGE COMPRESSION
PART-A (2 MARKS)

1.	**(a)**	Define data redundancy in images.	**[L1][CO5]**	**[2M]**
	(b)	Discuss the different Image Formats	**[L1][CO5]**	**[2M]**
	(c)	Write short note on compression standards.	**[L1][CO5]**	**[2M]**
	(d)	Explain sub-band coding,	**[L1][CO5]**	**[2M]**
	(e)	What is the difference between 1D and 2D wavelet transforms?	**[L1][CO5]**	**[2M]**

PART-B (10 MARKS)

2.	**(a)**	Explain the Coding Redundancy with suitable example.	**[L2] [CO5]**	**[5M]**
	(b)	Explain the Spatial and Temporal Redundancy with suitable example.	**[L2] [CO5]**	**[5M]**
3.	**(a)**	Define Entropy and irrelevant information.	**[L2] [CO5]**	**[5M]**
	(b)	Explain the functional block diagram of a general image compression system	**[L2] [CO5]**	**[5M]**

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<table>
<tr><td rowspan="2">4.</td><td>(a)</td><td>Explain the procedure for Huffman coding for image compression method.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Consider an image strip of size 50 × 100. The image consists of five vertical stripes. The gray levels of the stripes are 128, 64, 32, 16 and 8. The corresponding widths of the stripes are 35, 30, 2 0, 10 and 5 pixels respectively. If this stripe image coded is by Huffman coding, determine its efficiency.</td><td>[L3] [CO5]</td><td>[5M]</td></tr>
<tr><td rowspan="2">5.</td><td>(a)</td><td>Describe Golomb coding in detail. Explain its encoding procedure and applications in image compression.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Describe the working of the Lempel–Ziv–Welch (LZW) coding technique</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>6.</td><td></td><td>Explain the procedure for Arithmetic coding with suitable example.</td><td>[L2] [CO5]</td><td>[10M]</td></tr>
<tr><td rowspan="2">7.</td><td>(a)</td><td>Explain the Run length coding with proper example.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Compute the average length, compression and coding redundancy if the computer-generated image has the intensity distribution shown in table. If a natural 8-bit code is used to represent its 4 possible intensities.
<table>
<tr><td>Intensities r_k</td><td>Probabilities P_k</td></tr>
<tr><td>r87=87</td><td>0.25</td></tr>
<tr><td>r128=128</td><td>0.47</td></tr>
<tr><td>r186=186</td><td>0.25</td></tr>
<tr><td>r256=256</td><td>0.03</td></tr>
<tr><td>r_k for k≠87,128,186,256</td><td>0</td></tr>
</table></td><td>[L4] [CO5]</td><td>[5M]</td></tr>
<tr><td rowspan="2">8.</td><td>(a)</td><td>Differentiate lossy compression process and lossless compression process.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Explain token-based coding technique. Discuss its advantages in image compression.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td rowspan="2">9.</td><td>(a)</td><td>Identify the coding technique which is based on the concept of decomposing a multilevel image into a series of binary images. Explain its working mechanism.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Explain the principle of block transform coding used in image compression.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td rowspan="2">10.</td><td>(a)</td><td>Explain the principle of predictive coding used in image compression with block diagram for encoder and decoder.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Explain Image Pyramids and their applications in image compression and image blending.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td rowspan="2">11.</td><td>(a)</td><td>Discuss the 1D Wavelet Transform and its extension to 2D Wavelet Transform for image processing. Explain the filtering and down sampling operations involved.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Describe wavelet coding with a neat block diagram. Mention its advantages in image compression.</td><td>[L2] [CO5]</td><td>[5M]</td></tr>
</table>

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UNIT –V
IMAGE SEGMENTATION AND COLOR IMAGE PROCESSING
PART-A (2 MARKS)

1.	**(a)**	Define image segmentation	**[L1][CO6]**	**[2M]**
	(b)	Differentiate between region growing and region splitting.	**[L1][CO6]**	**[2M]**
	(c)	Define morphological erosion	**[L1][CO6]**	**[2M]**
	(d)	What are the three basic attributes of color?	**[L1][CO6]**	**[2M]**
	(e)	Why is color information useful in segmentation?	**[L1][CO6]**	**[2M]**

PART-B (10 MARKS)

2.	**(a)**	Discuss the fundamentals of image segmentation and explain the classification of segmentation techniques with examples.	**[L2] [CO6]**	**[5M]**
	(b)	Explain point detection techniques in image segmentation.	**[L2] [CO6]**	**[5M]**
3.	**(a)**	Explain line detection techniques in image segmentation.	**[L2] [CO6]**	**[5M]**
	(b)	Illustrate edge detection with necessary mathematical operators.	**[L3] [CO6]**	**[5M]**
4.		Describe thresholding techniques for image segmentation and explain the various methods of thresholding in detail.	**[L2] [CO6]**	**[10M]**
5.	**(a)**	Discuss region-based image segmentation techniques. Explain region growing and region splitting & merging.	**[L2] [CO6]**	**[10M]**
6.	**(a)**	Explain morphological image processing operations and algorithms in detail.	**[L2] [CO6]**	**[5M]**
	(b)	Explain erosion and dilation with mathematical expressions and examples.	**[L2] [CO6]**	**[5M]**
7.	**(a)**	Describe opening and closing operations. Explain their applications in noise removal and shape analysis.	**[L2] [CO6]**	**[5M]**
	(b)	Explain basic morphological algorithms for a) Boundary extraction b) Thinning	**[L2] [CO6]**	**[5M]**
8.	**(a)**	Explain gray-scale morphology and its importance.	**[L2] [CO6]**	**[5M]**
	(b)	Explain morphological watershed segmentation. Describe the algorithm and its applications.	**[L2] [CO6]**	**[5M]**
9.	**(a)**	Explain color image processing fundamentals. Discuss color models (RGB, CMY) and their applications.	**[L2] [CO6]**	**[10M]**
	(b)	Explain pseudo color image processing techniques.	**[L2] [CO6]**	**[5M]**
10.	**(a)**	Write short notes on basics of full color image processing	**[L2] [CO6]**	**[5M]**
	(b)	Explain noise in color images and its reduction.	**[L2] [CO6]**	**[5M]**
11.	**(a)**	Explain color image processing transformations	**[L2] [CO6]**	**[5M]**
	(b)	Explain color image compression and list its advantages.	**[L2] [CO6]**	**[5M]**