23MTPE412

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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Model Question Paper

Seventh Semester BE Degree Examination

Digital Image Processing

Time: 3 Hours(180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	M	L	C
Q1	a.	Explain the main components of a digital image processing system.	08	L2	CO1
	b.	Illustrate the processes of sampling and quantization involved in converting a continuous image into a digital image.	06	L2	CO1
	c.	Describe the 4-neighbors, diagonal neighbors, and 8-neighbors of a pixel.	06	L2	CO1
		OR			
Q2	a.	Explain the sequence of steps involved in digital image processing.	08	L2	CO1
	b.	Describe the role of image sensors in an image processing system.	06	L2	CO1
	c.	Illustrate image acquisition using a sensor array.	06	L2	CO1
		Module- 2			
Q3	a.	Explain the purpose of the log transformation in digital image processing.	08	L2	CO3
	b.	Utilizing the log transformation function $$s = c\log(1 + r)$$ where $c = 30$, calculate the transformed pixel intensities for the input values $r = 10, 50, 120, 200$. Based on the obtained results, interpret how the log transformation enhances the dark regions of an image and affects the bright regions.	06	L3	CO3
	c.	Apply a 3 × 3 mean filter to the following image window and determine the filtered value of the centre pixel. $$\begin{bmatrix} 120 & 125 & 130 \\ 118 & 122 & 128 \\ 115 & 120 & 125 \end{bmatrix}$$ The mean filter mask is given by $$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$ Calculate the output pixel value at the centre of the image window.	06	L3	CO3
		OR			
Q4	a.	Explain the significance of the Power Law (Gamma) Transformation in image enhancement.	08	L2	CO3
	b.	Utilizing the power law (gamma) transformation $$s = cr^{\gamma}$$ where $c = 1$ and $\gamma = 2.0$. Determine the transformed intensity values for the normalised pixel intensities $$r = 0.2, 0.4, 0.6, 0.8$$ Comment on the effect of using $\gamma = 2$ on the image.	06	L3	CO3

	c.	Compare histogram equalization and histogram matching techniques used in image enhancement. Given 64×64 image having 3-bit gray scales perform histogram equalization and draw the histogram of image before and after equalization. Intensity distribution is shown in table below.	06	L3	CO3

Gray Level (r_k)	**Number of Pixels (n_k)**
$r_o = 0$	790
$r_1 = 1$	1023
$r_2 = 2$	850
$r_3 = 3$	656
$r_4 = 4$	329
$r_5 = 5$	245
$r_6 = 6$	122
$r_7 = 7$	81

Module - 3

Q5	a.	Explain the steps for filtering in frequency domain.	08	L2	CO4
	b.	Consider the following 2 × 2 image matrix: $$f(x,y) = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$ i. Compute the 2-D Discrete Fourier Transform (DFT) of the image. ii. Determine the frequency domain coefficients $F(u,v)$.	06	L3	CO4
	c.	A frequency domain filter is defined with a cut-off frequency $D_0 = 30$ .The distance from the origin in the frequency plane for a pixel is D (u , v) = 20. The Ideal Lowpass Filter is defined as $$H(u,v) = \begin{cases} 1, & D(u,v) \leq D_0 \\ 0, & D(u,v) > D_0 \end{cases}$$ Determine the value of $H(u,v)$.	06	L3	CO4

OR

Q6	a.	Explain image sharpening using ideal, butterworth, and gaussian high-pass filters.	08	L2	CO4
	b.	The frequency spectrum of an image is $$F(u,v) = \begin{bmatrix} 18 & 24 & 18 \\ 24 & 90 & 24 \\ 18 & 24 & 18 \end{bmatrix}$$ The low-pass filter is $$H(u,v) = \begin{bmatrix} 0.3 & 0.6 & 0.3 \\ 0.6 & 1.0 & 0.6 \\ 0.3 & 0.6 & 0.3 \end{bmatrix}$$ Compute the filtered frequency spectrum $G(u,v) = H(u,v) \times F(u,v)$.	06	L3	CO4

	c.	A Butterworth Low-Pass Filter is $$H(u,v) = \frac{1}{1 + \left(\frac{D(u,v)}{D_0}\right)^{2n}}$$ Where $D_0 = 40$, $n = 2$ Calculate the filter response for **Frequency** / **Distance**: P1 – 10; P2 – 20; P3 – 40; P4 – 60; P5 – 80	06	L3	CO4
Module - 4					
Q7	a.	Describe the order-statistic filters used for image restoration.	08	L2	CO5
	b.	Consider the image = {12, 13, 14, 15, 17, 18, 19, 20. 12}.Find the pixel value to replace the central pixel in case of a median, a max, a min, a midpoint, and an alpha-trimmed filter.	06	L3	CO5
	c.	A grayscale image contains the following 3 × 3 neighbourhood of pixel intensities: $$\begin{bmatrix} 35 & 40 & 38 \\ 42 & 255 & 39 \\ 37 & 41 & 36 \end{bmatrix}$$ Determine the restored centre pixel using the following order-statistic filters: i. Median filter ii. Max filter iii. Min filter	06	L3	CO5
OR					
Q8	a.	Explain the morphological operations of erosion and dilation with suitable diagrams.	08	L2	CO5
	b.	Consider the following noisy image neighbourhood: $$\begin{bmatrix} 12 & 15 & 16 \\ 18 & 250 & 19 \\ 20 & 22 & 24 \end{bmatrix}$$ Determine the output of the Median Filter.	06	L3	CO5
	c.	Consider the binary image $$A = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{bmatrix}$$ Using the structuring elements $$B_1 = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$$ $$B_2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$ i. Perform the Hit-or-Miss Transformation. ii. Identify the locations where the specified pattern is detected.	06	L3	CO5

Frequency	Distance
P1	10
P2	20
P3	40
P4	60
P5	80

Module - 5					
Q9	a.	Explain the concept of edge detection in image segmentation.	08	L2	CO2
	b.	Describe how gradient operators help detect edges in images.	06	L2	CO2
	c.	Illustrate the concept of region growing in image segmentation.	06	L2	CO2
OR					
Q10	a.	Explain the concept of global thresholding in image segmentation.	08	L2	CO2
	b.	Interpret the advantages of Otsu's method compared with simple global thresholding.	06	L2	CO2
	c.	Describe how region splitting and merging can be used for image segmentation.	06	L2	CO2

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