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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E.   **Semester: VI**

Branch: Medical Electronics Engineering   **Duration: 3 hrs.**

Course Code: 23MD6PCMIP / 22MD6PCMIP / 19ML6PCMIP   **Max Marks: 100**
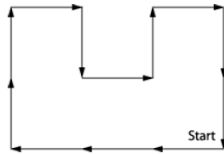
Course: Medical Image Processing

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			UNIT - I	CO	PO	Marks
1	a)		Calculate the file size of a BMP image with 8 bits per color channel for an RGB image of size 100x100. How many minutes would it take to transmit this image along with one start and one stop bit using a baud rate of 2400bits/sec.	CO1	PO1	4
	b)		Consider the image segment shown below Let V= {0, 1, 2, 3} Identify the shortest 4, 8 and m- paths between pixels p and q. Also find the path lengths. If path does not exist justify why?	CO1	PO1	8

<table>
<tr><td>3</td><td>4</td><td>1</td><td>2</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>4</td><td>2 (q)</td></tr>
<tr><td>2</td><td>2</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>3 (p)</td><td>0</td><td>4</td><td>2</td><td>1</td></tr>
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		If p and q have spatial location as (80,122) and (100,114) respectively. Compute the Manhattan distance between them.				
	c)	Develop a schematic which represents the essential blocks of a CAD tool for brain MRI image analysis which will also facilitate easy access of data for remote sensing application. Briefly explain the function of each block in schematic.	CO1	PO1	8
		OR			
2	a)	Discuss the framework to identify neighbors of a pixel in a digital image with relevant mathematical expressions. Prove that the choice of neighborhood affects the connectivity of regions in the image.	CO1	PO1	10

				CO	PO	Marks
		b)	Differentiate between Sampling and Quantization processes in digital image processing. What is the effect of image zooming and shrinking on the quality of a digital image	CO1	PO1	10
			UNIT - II			
3		a)	Determine and plot the Probability Distribution Function (PDF) after applying histogram equalization for the given image information. Mention applications of histogram equalization.	CO2	PO2	7

r_k	0	1	2	3	4	5	6	7
n_k	790	1023	850	656	329	245	122	81

				CO	PO	Marks
		b)	What is the difference in log transform and gamma correction? Discuss with the help of relevant equation and plots.	CO2	PO2	8
		c)	Which image sharpening filter is isotropic in nature? Explain why?	CO2	PO2	5
			OR			
4		a)	How will you perform edge enhancement through image smoothing? Discuss the steps in the algorithm.	CO2	PO2	7
		b)	Using suitable image enhancement algorithm how can you encode the below given 4 bit image data to view the image in various planes? Discuss the objectives of this algorithm.	CO2	PO2	7

15	3	9	10	11	6	9	4
9	12	15	7	1	3	5	5
1	11	8	2	13	14	6	6

				CO	PO	Marks
		c)	What will be the output image after applying Laplacian filter of size 3 on center pixel for the image f (x, y) considering i. 4- connectivity mask ii. 8- connectivity mask	CO2	PO2	6

0	1	0	6	5
2	3	1	2	5
1	2	**7**	5	4
1	0	6	5	2
2	3	5	7	6

				CO	PO	Marks
			UNIT - III			
5		a)	How will you reduce multiplicative noise in a digital image captured in low ambient light and also enhance image reflectance Discuss the algorithm and elaborate how illumination correction is achieved through the proposed algorithm.	CO2	PO2	10
		b)	Identify the filter reprsented below and discuss its performance in performing image enhancement using relevant graphs and equations	CO2	PO2	10

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			OR			
6	a)	Explain the operations performed in transforming an image f(x,y) to g(x,y) in a frequency domain. Give the purpose of each step used in the process.		CO2	PO2	10
	b)	What is ringing effect in digital image processing? Discuss the performance of filters in frequency domain used to enhance fine details in an image.		CO2	PO2	10
			UNIT - IV			
7	a)	Discuss how image restoration is different from enhancement.		CO2	PO2	5
	b)	Apply alpha trimmed mean filter of size 5 to the below given image data. Assume d = 4.		CO1	PO2	8

10	50	200	55	60
12	52	210	58	65
11	53	220	59	62
15	51	215	57	61
13	54	205	56	64

	c)	Exemplify the operation of following filters used for image restoration
		    i. Geometric mean filter
		    ii. Contra harmonic mean filter
				CO2	PO2	7

			OR			
8	a)	Identify suitable filter to reduce high density impulse noise in restoring original image. Discuss the process with suitable algorithm.		CO2	PO2	7
	b)	Discuss any three noise probability density functions used in image restoration process.		CO2	PO2	7
	c)	What are the reasons for image degradation? Explain the additive noise image degradation model.		CO2	PO2	6
			UNIT - V			
9	a)	Discuss the Otsu's thresholding algorithm with relevant equations and apply it to select optimal threshold for the following 3-bit image		CO2	PO2	10

0	1	1	2
2	5	5	4
6	7	6	2
4	6	5	5

Between class variance for all possible thresholds is as given below

t	1	2	3	4	5	6
σ_b^2	1.5	2.5	7	3.5	2	1

1. Analyze the optimal threshold value based on the given data?
2. Binarize the image data based on this threshold to give output image.

		b)	Identify 4 directional and 8 directional Chain Code and compute shape number for the following image. Prove that shape no. is position and rotation invariant.	*CO2*	*PO2*	**10**

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OR

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10	a)	Discuss the steps of region growing image segmentation algorithm with its advantages and disadvantages. Then, apply this algorithm to the below given image data. Assume that Threshold ≤ 4 and seed point is at (2,2)	*CO2*	*PO2*	**10**

3	6	5	4	2
1	0	7	6	4
3	2	1	4	5
3	4	4	7	3
1	1	2	5	2

	b)	Perform segmentation on the following image using region splitting-merging algorithm. Draw the quad tree. Predicate is max $(x, y) - \min (x, y) \leq 3$	*CO2*	*PO2*	**10**

6	7	6	7	5	5	4	4
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
0	3	2	3	3	2	4	7
0	0	0	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	4

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