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 **PRESIDENCY UNIVERSITY**

  **Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 17 – 01- 2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** B. Tech ECE |
| **Course Code:** ECE3029 | **Course Name:** Digital Image Processing |
| **Semester**: V | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** |
| **Marks** | **24** | **22** | **28** | **26** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20 Marks** |
| **1** | A digital image consisting of pixels is of size M\*N, each pixel is of ‘k’ bits and ‘L’ number of intensity levels. How many bits are required to store this digital image? | **2 Marks** | **L1** | **CO1** |
| **2** | Consider a pixel ‘p’ with coordinates (x,y). Write the coordinates of the 4-neighbours and the diagonal neighbours of pixel ‘p’. | **2 Marks** | **L1** | **CO1** |
| **3** | Two-dimensional intensity arrays suffer from three principal types of data redundancies. Name them. | **2 Marks** | **L1** | **CO3** |
| **4** | Name the transformation and draw the transformation curve that reverses the intensity levels of input image whose transformation function takes the form s = L-1-r, where, s and r represent intensity levels of output and input image respectively and L is the intensity level. | **2 Marks** | **L1** | **CO2** |
| **5** | Draw the probability density function of Gaussian noise and Exponential noise. | **2 Marks** | **L1** | **CO3** |
| **6** | * 1. Mixing secondary color of light with its opposite primary color yields \_\_\_\_\_\_\_\_\_\_\_\_\_\_ color.
	2. Mixing all primary colors of light yields \_\_\_\_\_\_\_\_\_\_\_\_\_\_ color.
 | **2 Marks** | **L1** | **CO4** |
| **7** | Histogram of noisy images are shown in figures ‘a’ and ‘b’. Identify the type of noise by comparing the histogram to the noise probability density function.

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| Figure a | Figure b |

 | **2 Marks** | **L1** | **CO3** |
| **8** | While performing image segmentation, isolated points, lines and edges are the image features we are interested in detecting. Define isolated points and lines. | **2 Marks** | **L1** | **CO3** |
| **9** | Identify the most suitable color models used for the following applications.1. For color printing
2. For color monitor display and in color cameras
 | **2 Marks** | **L1** | **CO4** |
| **10** | Identify the most suitable morphological operation that 1. **can split apart joined objects shown below.**

1. **can repair intrusions shown below.**

 | **2 Marks** | **L1** | **CO4** |

**Part B**

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| **Answer the Questions. Total Marks 80** |
| **11.** | Huffman coding is a lossless data compression algorithm. In this algorithm, variable-length code is assigned to different source input characters. The code length is related to how frequently characters are used. Most frequent characters have the smallest codes and longer codes for least frequent characters. 1. Generate the Huffman Code for an information source producing a sequence of alphabets “S1 to S7” with respective probabilities of occurrence as shown in the table below.

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| **Alphabets** | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** |
| **Probabilities** | **0.4** | **0.2** | **0.1** | **0.1** | **0.1** | **0.05** | **0.05** |

1. Accordingly, list the Huffman Code of all the alphabets “S1” to “S7”.
2. Find the Average Length L of the alphabets after compression.
3. Compute the source entropy**.**
 | **20 Marks** | **L3** | **CO3** |
| **or** |
| **12.** | Segmentation subdivides an image into its constituent regions or objects and is one of the most difficult tasks in image processing. Its accuracy determines the eventual success or failure of the computerized analysis. To extract basic features such as points, edges and lines by abrupt changes in intensity we use derivatives. An image strip ‘X’ shows a section of horizontal intensity profile taken from a glass building of a mall, identify the cracks by using 1st and 2nd derivative method. Draw the intensity profile of ‘X’ and label the step edge, ramp edge, point, and line as applicable.  | **20 Marks** | **L3** | **CO3** |
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| **13.** | Erosion and Dilation are the two fundamental operations in morphological image processing from which all the other morphological operations are based. They were originally defined for binary images, later being extended to grayscale images and subsequently to complete lattice. Dilation adds pixels to the boundaries of objects in an image while erosion removes pixels on object boundaries. Consider a binary image A, and the structuring element B1 given below. Perform the following morphological operations.1. **A erosion B1**
2. **Ac  erosion B1**
3. **A dilation B1**
4. **Ac  dilation B1**

 | **20 Marks** | **L2** | **CO4** |
| **or** |
| **14.** | Explain the process of intensity slicing/ density slicing applied for pseudocolor image processing considering two slicing planes. | **20Marks** | **L2** | **CO4** |

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| **15.** | In digital image processing, there are various set and logical operations. While dealing with binary images the foreground (1-valued) and background (0-valued) sets of pixels, we refer Union, Intersection and Compliment (set operations) as the OR, AND and NOT logical operations respectively. Considering the two regions (Sets) B1 and B2 as shown in figure below, perform the following Logical Operations. 1. **NOT (B1)**
2. **NOT (B2) AND B1**
3. **(B1) AND (B2)**
4. **(B1) OR (B2)**

 | **20Marks** | **L3** | **CO1** |
| **Or** |
| **16.** | A digital image is defined by the mathematical function f(x,y), where x and y are the two co-ordinates horizontally and vertically, with an amplitude of “f” at any pair of coordinate (x, y) being called the intensity or gray level of the image at that point. Processing of a digital image requires various Pixel–Neighbors relationship such as N4, ND, N8 and various distance measures between pixels such as De, D4, D8 etc. Consider the given below sample image segment of 8 x 8 pixels having intensity values ranging from {0 to 9}: where for pixel P intensity value is 4 and co-ordinates is (6,2) and Q intensity value is 8 with co-ordinates (2,6). 1. Determine the Euclidian distance between pixel P and Q.
2. Determine the City Block distance between pixel P and Q.
3. Determine the Chess-Board distance between pixel P and Q.
4. Determine the Dm distance between pixel P and Q.
 | **20Marks** | **L3** | **CO1** |

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| **17.** | Histogram is a graphical representation of the intensity distribution of an image. In simple terms, it represents the number of pixels for each intensity value considered. Consider a gray scale image in matrix form.1. Perform Histogram Equalization (HE) on this image and scale the intensity to 1:20.
2. Draw histogram of input image and HE image.

 | **20Marks** | **L3** | **CO2** |
| **Or** |
| **18.** | For a 3-bit 4X4 image segment given below.1. Perform thresholding operation with T= 5.
2. Also find its Digital negative.
3. If identity transformation is performed on this image what will be its pixel values.
4. If bit plane slicing transformation is applied, extract the most significant plane of this image segment.

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

 | **20Marks** | **L3** | **CO2** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***