Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY/ JUNE 2025

Date: 03-06-2025 **Time:** 09:30 am – 12:30 pm

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

CO - Levels	CO1	CO2	CO3	CO4
Marks	12	12	38	38

Instructions:

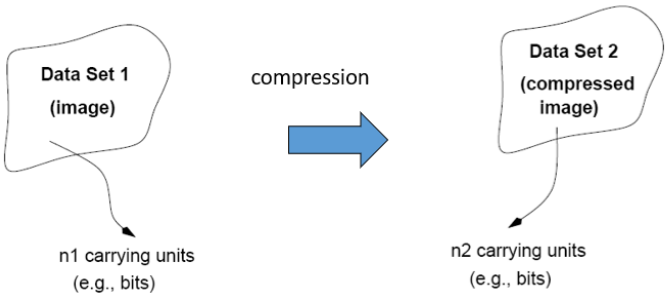
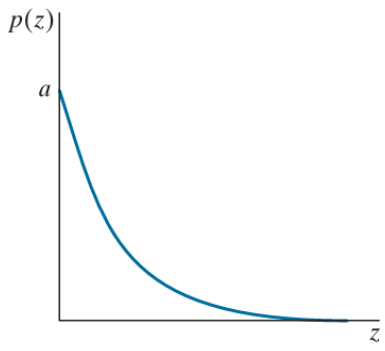
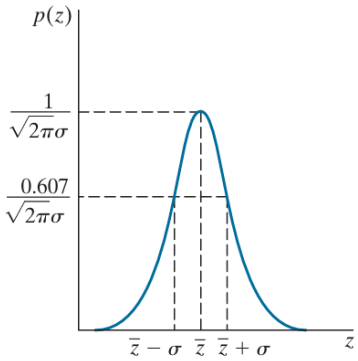
(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1	Any color of visible spectrum can be obtained by combining primary and secondary colors and allowing the wavelengths to vary. List the primary colors of light and primary colors of pigment.	2 Marks	L1	CO4
2	There are three leading color models for image processing namely RGB, CMY, and HSI model. What led to the development of CMYK model?	2 Marks	L1	CO4
3	A powerful and simple structure for representing images at more than one resolution is image pyramid. Name the two different types of image pyramids that can be generated for analyzing images.	2 Marks	L1	CO4
4	Identify the most suitable color models used for the following applications: For color monitor display and in color cameras.	2 Marks	L1	CO4
5	Segmentation is considered to be the most difficult task in image processing. List the conditions that must be satisfied for segmenting an image.	2 Marks	L1	CO3
6	Determine the compression ratio and data redundancy for the figure shown below.	2 Marks	L1	CO3

				
7	**Every noisy image has intensity values that are associated with a probability density function (PDF). Identify the noise related to the following most common PDF found in image processing applications shown below.**  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 edges of an image.**	**2 Marks**	**L1**	**CO3**
9	**One of the most important classifications of an image processing method is whether it is linear or nonlinear. A system or an operator is said to be Linear if it satisfies _____ and _____properties.**	**2 Marks**	**L1**	**CO1**
10	**There are applications in which it is of interest to highlight a specific range of intensities in an image. Some of these applications include enhancing features in satellite imagery, such as masses of water, and enhancing flaws in X-ray images. Identify transformation that highlights a specific range of intensities of an image?**	**2 Marks**	**L1**	**CO2**

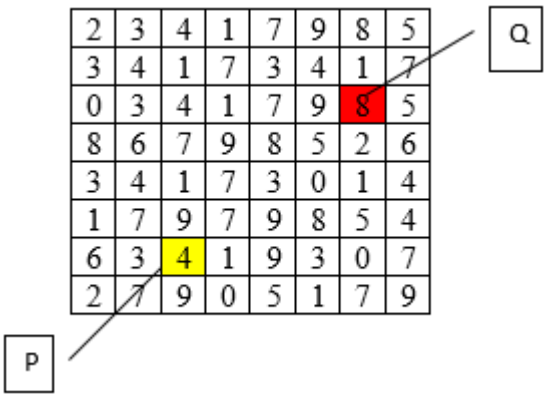
Part B

Answer the Questions. **Total Marks 80**

11.	**In digital image processing, there are various set and logical operations. While dealing with binary images shown below, the foreground (1-valued) and background (0-valued) sets of pixels, we refer Union, Intersection and Compliment (set operations) as**	**10Marks**	**L2**	**CO1**

	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. **i. NOT (B2) AND B1** **ii. (B1) AND (B2)**  			

or

12.	**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).**  **a) Determine the City Block distance between pixel P and Q.** **b) Determine the Chess-Board distance between pixel P and Q.**	**10Marks**	**L2**	**CO1**

13.	**Pixel values are integers composed of bits. Values in a 256-level gray scale image is composed of 8 bits (one byte). A gray scale image segment with 4*4 pixels is shown below. Perform a suitable**	**10 Marks**	**L2**	**CO2**

	transformation that can show the contribution of only S8, S6, S4, and S2 planes. Also list the advantages of this transformation. 132 14 38 232 129 64 78 33 32 155 198 126 129 164 178 233			

or

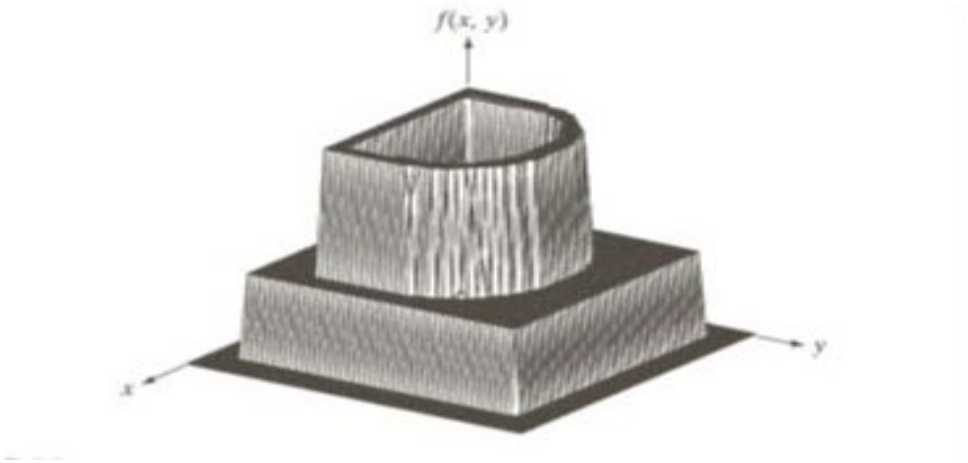
14.	Draw the intensity transformation curves of negative, log, identity, power law with gamma = 0.2 and inverse log transformations. Write the value of output pixel 's' in terms of input pixel 'r' for each transformation.	10Marks	L2	CO2

15.	Abrupt local changes in intensity can be detected using derivatives. These derivatives of a digital function (digital image) are defined in terms of differences. Formulate suitable 1st and 2nd derivatives that can be applied for a line segment and list their properties.	10 Marks	L3	CO3

Or

16.	An information source produces a sequence of independent symbols having the following probabilities. A natural binary encoding assigns the same number of bits to both the most and least probable values, failing to minimize the symbols a1 to a6 shown below and resulting in coding redundancy. Symbol | a1 | a2 | a3 | a4 | a5 | a6 Probability | 0.1 | 0.4 | 0.06 | 0.1 | 0.04 | 0.3 a) Construct a binary code using variable length coding namely Huffman coding for all the symbols a1 to a6. b) Compute the source entropy.	10 Marks	L3	CO3

17.	Consider a 3- dimensional image. (plot of intensity axis f(x,y), coordinate axis x and y) as shown below. Perform intensity slicing with 2 slicing planes. Explain this process with the help of mapping function that takes a staircase form.	10Marks	L3	CO4

Or

18.	**List the steps for creating pyramids with the help of an approximation filter, interpolation filter, up sampler and down sampler.**	**10Marks**	**L3**	**CO4**

19.	**A computer-generated image has the intensity distribution shown in Table below. If a natural 8-bit binary code is used to represent its four possible intensities, find L_{avg}. If a variable length coding is used, find L_{avg}. Compress the given intensities using variable length code that performs a series of source reductions by ordering the probabilities of the symbols under consideration, then combining the lowest probability symbols into a single symbol that replaces them in the next source reduction.** r_k | $p_r(r_k)$ $r_{87} = 87$ | 0.25 $r_{128} = 128$ | 0.47 $r_{186} = 186$ | 0.25 $r_{255} = 255$ | 0.03 r_k for $k = 87, 128, 186, 255$ | 0	**20 Marks**	**L3**	**CO3**
	Or			
20.	**Explain a model of image degradation and restoration process. Also prove that image degradation operator 'H' is linear and position invariant.**	**20 Marks**	**L2**	**CO3**

21.	**Dilation adds pixels to the boundaries of objects in an image while erosion removes pixels on object boundaries. Accordingly,**	**20 Marks**	**L2**	**CO4**

	consider a Binary image A, and the sub image B2 given below, perform the following operations: A erosion B2, A^c erosion B2, A dilation B2 and A^c dilation B2. Image A 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 1 1 1 1 1 0 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 B2 1 1 1. 1 1			
Or				
22.	**Mathematical morphology is used as a tool for extracting image components that are useful in the representation and description of region shape, such as boundaries, skeletons, and the convex hull. In image processing, we use morphology with two types of sets of pixels: image containing objects and structuring elements (SE's). Given an Image A and its structuring element. Compute the Output Image in for each operation given below.** 1. $A^c \theta B$ 2. $A \theta B$ 3. $A^c \oplus B$ 4. $A \oplus B$ Input Image A | Structuring Element with Origin A 0 0 0 0 0 0 0 0 1 1 0 0 0 1 1 1 1 0 0 0 1 1 0 0 0 0 0 0 0 0 B 1 1. 1	**20 Marks**	**L2**	**CO4**