National Institute of Technology Delhi

Name of the Examination: B.Tech

Mid Semester Examination (Spring, Feb-2026)

Branch	: CSE	Semester	: VI
Title of the Course	: Computer Vision	Course Code	: CSBB 314
Time	: 1.5 hours	Maximum Marks	: 25

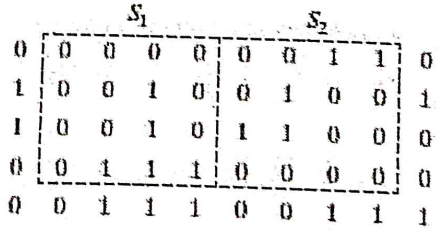
COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Understand foundational concepts of Image Processing and its applications	L1, L2
CO2	Apply the principal mathematical tools used in digital image processing.	L2, L3
CO3	Apply foundational concepts of deep learning, including neural networks, training methods, and optimization techniques.	L3, L4
CO4	Develop and evaluate convolutional neural networks (CNNs) for image classification and object detection	L6

Attempt all questions from each section.

Section-A (1x 5 = 5 Marks)

Qs. No.	Question	CO	BL	PO
1.	Write down the Filters used to generate horizontal and vertical blur of an image.	CO2	L1	PO1
2.	Write the Discrete Laplacian Convolution Mask for 4-Neighbourhood	CO1	L1	PO1
3.	Discuss the general form of the log transformation.	CO2	L2	PO1
4	Which filter is preferred for removing salt-and-pepper noise in an image?	CO2	L1	PO2
5	Write down the equation of the Gaussian kernels used for image smoothing.	CO2	L1	Po2

Section-B (2.5 x 4 = 10 Marks)

Qs. No.	Question	CO	BL	PO
6.	Consider the two image subsets, S1 and S2, in the following figure. Assuming that V = {1}, determine whether these two subsets are: (a) 4-adjacent, (b) 8-adjacent and (c) *m*-adjacent. 	CO2	L1	PO2
7.	A 4-bit digital image is represented as $I = [I(x, y)]_{M\times N}$, $I(x,y) \in [0,15]$, where M and N define the resolution of an image (I), x, y represent the coordinates, and I(x,y) can be given as follows: $I(x, y) = \sum_{k=0}^{3} b_k(x, y)2^k, \quad b_k \in \{0, 1\}$	CO2	L2	PO2

	Where b_k denotes bits from MSB → LSB, i.e., (*b3 b2 b1 b0*). Find the pixel values of the 4-bit image and plot the histogram.			
8.	Considering the problem statement shown in Q(7), find all the bit planes of the 4-bit image generated.	CO1	L2	PO2
9.	Differentiate between image sampling and image quantisation in terms of resolution, purpose, and their effects on image quality.	CO1	L1	PO1

Section-C **(5 x 2 = 10 Marks)**

Qs. No.	Question	CO	BL	PO
10.	In image processing, a pixel at location (x, y) is transformed to a new location (x', y') using a geometric transformation. Explain how x' and y' are obtained for the Translation, Scaling and Rotation. Also, For a point P(2,3), find its new position after: (i) Translation by (3,2) (ii) Scaling by 2 in both directions (iii) Rotation by 90° anticlockwise.	CO1	L3	PO2
11.	Consider a digital image having gray levels: $r_k = \{0,1,2,3,4\}$, $k = 0,1,2,3,4$ Let the total number of pixels in the image be N. Assume that all gray levels occur with equal frequency, i.e., $n(r_k) = N/5$, $k = 0,1,2,3,4$ where $n(r_k)$ denotes the number of pixels having gray level r_k. The probability distribution of the input image is given by: $P(r_k) = n(r_k) / N$, $k = 0, 1, 2, 3, 4$ The desired gray levels are $z_j = \{0,2,4,5,7\}$, $j = 0,1,2,3,4$ Assume that the desired histogram satisfies: $n(z_0) = 0$, $n(z_1) = 0.2N$, $n(z_2) = 0.4N$, $n(z_3) = 0.4N$, $n(z_4) = 0$ The probability distribution of the specified histogram is defined as: $P(z_j) = n(z_j) / N$, $j = 0, 1, 2, 3, 4$ Perform histogram specification and determine the gray-level transformation function. In case of ambiguity, choose the higher cumulative probability.	CO2	L3	PO3