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CBCS SCHEME

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BEC/BTE/BVL613C

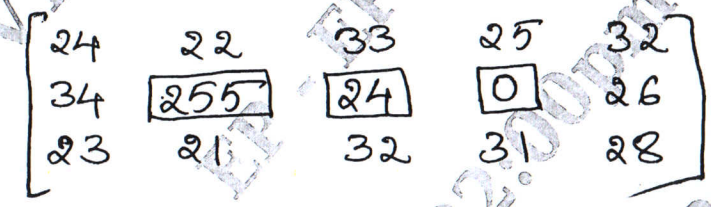
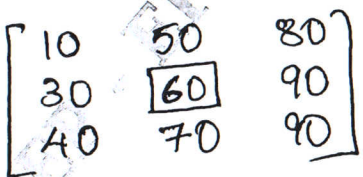
Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026
Digital Image Processing

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Any missing data can be assumed suitably.

		Module – 1	M	L	C
Q.1	**a.**	With a neat block diagram, explain the components of a general purpose image processing system.	**10**	**L2**	**CO1**
	b.	Given a palm tree 15 m tall located 100 m from the human eye (cornea + lens), what would be the length of its inverted image formed on the retina of the eye? Assume the distance between center of the lens and the retina along the visual axis is approximately 17 mm.	**4**	**L3**	**CO1**
	c.	Let V = {1, 2}. Compute the lengths of the shortest 4-, 8- and m-path between 'p' and 'q' for the image segment given below. If path does not exist, explain why? $\begin{bmatrix} & 3 & 1 & 2 & 1 & (q) \\ & 2 & 2 & 0 & 2 & \\ & 1 & 2 & 1 & 1 & \\ (p) & 1 & 0 & 1 & 2 & \end{bmatrix}$	**6**	**L3**	**CO1**
		OR			
Q.2	**a.**	With neat diagrams and necessary mathematical equations explain the process of 2D (two dimensional) sampling and quantization.	**10**	**L2**	**CO1**
	b.	Given a 8-bit 2 × 2 image $\begin{bmatrix} 100 & 50 \\ 70 & 20 \end{bmatrix}$, zoom the image to 3 × 3 using bilinear interpolation.	**4**	**L3**	**CO1**
	c.	Let V = {0, 1, 2}. Compute the following distances: D_e, D_4, and D_8 between the pixels 'p' and 'q' for the image segment given below: $\begin{bmatrix} & 5 & 4 & 3 & 1 & 1 & (q) \\ & 5 & 4 & 0 & 2 & 0 & \\ & 3 & 2 & 0 & 2 & 4 & \\ & 2 & 1 & 1 & 3 & 5 & \\ (p) & 1 & 3 & 5 & 1 & 3 & \end{bmatrix}$	**6**	**L3**	**CO1**

		Module – 2			
Q.3	**a.**	For the 2 × 2 transform $A = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$ and the image $U = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ calculate the transformed image V and the basis images. Reconstruct U using the basis images.	**10**	**L3**	**CO2**
	b.	Obtain a 4 × 4 two-dimensional Haar transform matrix. Show all the steps.	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Discuss 2-D forward and inverse DCT and its properties.	**10**	**L3**	**CO2**
	b.	Given u(m, n) = {1 ; 0 ≤ m, n ≤ 3 , obtain v(k, *l*) using the unitary 2D DFT. Then, apply an inverse 2D IDFT (unitary) to reconstruct u(m, n).	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Perform histogram equalization on the given input image $\begin{bmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{bmatrix}$ i) Plot the histogram transformation function. ii) Write the histogram equalized image in the form of a matrix.	**10**	**L3**	**CO3**
	b.	Draw the transformation functions and explain the following intensity transformation techniques: i) Contrast stretching ii) Log transformation iii) Thresholding iv) Image Negative	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Given the input image $\begin{bmatrix} 0 & 6 & 6 \\ 1 & 2 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ perform i) Mean filtering ii) Weighted-mean filtering iii) Median filtering iv) Mid-point filtering On the center pixel by considering 3 × 3 neighbourhood.	**10**	**L3**	**CO3**
	b.	With necessary equations explain the following: i) Laplacian filter for image sharpening ii) Unsharp masking and high boost filtering	**10**	**L2**	**CO3**

		Module – 4			
Q.7	**a.**	Given RGB values (0.2, 0.4, 0.6), convert them to CMY and HSI colour models. Then, reconstruct the original RGB values from both CMY and HSI.	**10**	**L3**	**CO4**
	b.	State any two characteristics of ideal, Butterworth and Gaussian low-pass filters used in image processing. Also, write their transfer functions and sketch their radial cross-sections (H(u, v) versus D(u, v)).	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Compute H(u, v) at (10, 10) for ideal and Butterworth low-pass and high pass filters. Given : cutoff frequency $D_0 = 15$; Butterworth order n = 2; and D(u, v) = 20 at (10, 10).	**10**	**L3**	**CO4**
	b.	With necessary equations and diagrams, explain homomorphic filtering approach for image enhancement.	**10**	**L2**	**CO**
		Module – 5			
Q.9	**a.**	Apply adaptive median filtering on the boxed pixels using 3 × 3 mask. 	**10**	**L3**	**CO5**
	b.	Derive the expression for the observed image in the presence of noise, assuming the degradation is linear and position invariant. Also, state the mathematical definitions of linearity and position invariance of the degradation operator.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Apply the following filters to a boxed pixel value: Alpha – trimmed mean filter (d = 4), geometric mean, harmonic mean and contra-harmonic mean (Q = 1) filter 	**10**	**L3**	**CO5**
	b.	With necessary mathematical equations, explain inverse filtering and Wiener filtering in image processing.	**10**	**L2**	**CO5**

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