Roll No.

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2023

B.E. BIOMEDICAL ENGINEERING (Full Time)
Semester VII
BM5702 – PRINCIPLES OF DIGITAL IMAGE PROCESSING
(Regulation 2019)

Time: 3 hrs Max. Marks: 100

CO1	Process color images and compute image transforms
CO2	Preprocess the image using image enhancement and filtering techniques
CO3	Restore the degraded images
CO4	Segment the region of interest in images
CO5	Apply various compression techniques on images

BL – Bloom's Taxonomy Levels
(L1- Remembering, L2- Understanding, L3- Applying, L4- Analysing, L5- Evaluating, L6- Creating)

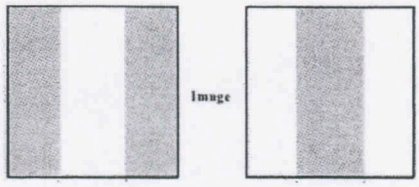
PART- A (10 x 2 = 20Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1.	What are the attributes of color images?	2	CO1	L1
2.	What are Singular values in SVD transform?	2	CO1	L1
3.	What is meant by histogram specification?	2	CO2	L1
4.	Give the pdfs of the following noise models: i) Uniform and ii) Erlang.	2	CO2	L2
5.	State the differences between simple thresholding and hysteresis thresholding:	2	CO3	L2
6.	Consider a one-dimensional image f(x) = 60 60 60 100 100 100. What is its second derivative?	2	CO3	L2
7.	What is the need for feature selection?	2	CO4	L1
8.	What are GLCM features?	2	CO4	L1
9.	What is run length coding?	2	CO5	L1
10.	State the difference between inter - pixel and intra - pixel redundancy:	2	CO5	L2

PART- B (5 x 13 = 65 Marks)
(Restrict to a maximum of 2 sub-divisions)

Q. No	Questions	Marks	CO	BL
11 (a) (i)	What is meant by full color, safe color and pseudo color in images? Explain any two color models with necessary diagrams.	(7)	CO1	L3
(ii)	Define spatial and intensity resolution. Describe the effects produced on an image when these resolutions are reduced.	(6)	CO1	L3
	OR			

11 (b) (i)	Determine the CIE chromaticity coordinates of a point given C_1 = (0.14, 0.4, 2) and C_2 = (0.51, 0. 6, 1). Find the third color C_3.	(5)	CO1	L3
(ii)	Find the forward DCT of: $f(x,y) = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix}$	(8)	CO1	L3
12 (a) (i)	What is meant by homomorphic filtering? List its advantages:	(7)	CO2	L3
(ii)	Differentiate between Smoothing and sharpening filters.	(6)	CO2	L3
	OR			
12 (b) (i)	With necessary equations, explain inverse filtering used in image restoration process along with its constraints.	(7)	CO2	L3
(ii)	A blur filter h(m, n) is given by: $h(m,n) = \begin{pmatrix} 0 & 0.1 & 0.1 & 0 \\ 0.1 & 0.1 & 0.1 & 0.1 \\ 0.05 & 0.1 & 0.1 & 0.05 \\ 0 & 0.05 & 0.05 & 0 \end{pmatrix}$ Give the steps to get deblur filter result using inverse filter approach.	(6)	CO2	L3
13 (a) (i)	What are the causes of edge in an image? What are 1st and 2nd order derivatives of an image? Also state why the 2nd derivative based operator is not used in its original form?	(7)	CO3	L4
(ii)	Explain the watershed algorithm with neat diagram. State its drawbacks and how it can be overcome.	(6)	CO3	L4
	OR			
13 (b) (i)	Consider the image shown below. Obtain the results of region growing algorithm : $\begin{pmatrix} 1 & 0 & 7 & 8 & 7 \\ 0 & 1 & 8 & 9 & 8 \\ 0 & 0 & 7 & 9 & 8 \\ 0 & 1 & 8 & 8 & 9 \\ 1 & 2 & 8 & 8 & 9 \end{pmatrix}$ Assume the seed points at the coordinates (3, 4) and (5,1). Choose different thresholds to indicate the results:	(7)	CO3	L4

(ii)	Suppose, we use edge models as shown in the following figures, Sketch the horizontal line profile, gradient and Laplacian of each profile with proper explanation: 	(6)	CO3	L4
14 (a) (i)	Explain about statistical and shape based features:	(5)	CO4	L4
(ii)	With a case study, explain how features are useful in medical image diagnosis:	(8)	CO4	L4
	OR			
14 (b)	Explain the need for PCA with a help of a case study related to medical data analysis:	(13)	CO4	L4
15 (a) (i)	Consider a 4 x 8 8-bit image: $\begin{bmatrix} 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \\ 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \\ 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \\ 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \end{bmatrix}$ Compress the image using Huffman coding.	(7)	CO5	L4
(ii)	What is the need for data compression? Give the differences between lossy and lossless compression.	(6)	CO5	L4
	OR			
15 (b)	Explain the data hierarchy of MPEG standard. Highlight on the frame formation, encoding and the prediction schemes.	(13)	CO5	L4

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16.	Consider a linear, position-invariant image degradation system with impulse response $h(x-\alpha, y-\beta) = e^{-[(x-\alpha)^2 + (y-\beta)^2]}$ Suppose that the input to the system is an image consisting of a line of infinitesimal width located at x=a, and modeled by f(x, y) = δ(x-a), where δ is an impulse. Assuming no noise, what is the output image g (x, y)?	(15)	CO3	L4