Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2024

B.E. BIOMEDICAL ENGINEERING (Full Time)

VII Semester

BM 5702 – 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 = 20 Marks)

(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	What is the number of bits required to store a 100×100 grayscale image with 256 gray levels?	2	CO1	L2
2	What is the DC component of the following image? $f = \begin{vmatrix} 1 & 3 & 4 \\ 5 & 6 & 7 \\ 8 & 9 & 11 \end{vmatrix}$	2	CO1	L2
3	What type of filtering is preferred if one is interested in high frequencies of an image? Give an example:	2	CO2	L2
4	What is Bit plane slicing? Illustrate with an example:	2	CO2	L1
5	What are the three basic types of gray level discontinuities in a digital image and give one method of detection for each:	2	CO3	L2
6	Define blind de-convolution and give two methods for estimating degradation function.	2	CO3	L1
7	What are the characteristics of a good feature obtained from an image?	2	CO4	L1
8	Name two transform features and its application:	2	CO4	L1
9	List two differences between lossy and loseless compression:	2	CO5	L1
10	Calculate the entropy for the symbols shown in the table below: Symbol: 1, 2, 3, 4, 5, 6 Probability: 0.4, 0.2, 0.2, 0.1, 0.05, 0.05	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)	Find the singular value Decomposition of the following matrix: $A = \begin{vmatrix} 1 & -2 & 3 \\ 3 & 2 & -1 \end{vmatrix}$	(13)	CO1	L3
	OR			
11 (b)	(i) Define resolution. Describe the effects produced on an image when resolution is reduced. Give examples and illustrate.	(7)	CO1	L3
	(ii) Explain the image formation model and representation of digital images with necessary diagrams.	(6)	CO1	L3
12 (a)	(i) A 4 x 4 image is given by: $\begin{pmatrix} 3 & 2 & 1 & 4 \\ 5 & 2 & 6 & 3 \\ 7 & 9 & 1 & 4 \\ 2 & 4 & 6 & 8 \end{pmatrix}$ Use a 3x3 smoothing mask giving higher weight age for the central pixel (Use zero padding):	(7)	CO2	L3
	(ii) Explain the enhancement transformation technique commonly used to enhance features such as masses of water in satellite imagery.	(6)	CO2	L3
	OR			
12 (b)	(i) With necessary equations, explain inverse filtering used in image restoration process:	(7)	CO2	L3
	(ii) A blur filter h(m, n) is given by $h(m, n) = \begin{pmatrix} 0 & 0.1 & 0.1 & 0 \\ 0.1 & 0.1 & 0.1 & 0.1 \\ 0.05 & 0.1 & 0.1 & 0.05 \\ 0 & 0.05 & 0.05 & 0 \end{pmatrix}$ Find the deblur filter result using inverse filter approach:	(6)	CO2	L3
13 (a)	Discuss about image segmentation using Morphological Watersheds and how the drawback of over segmentation is overcome?	(13)	CO3	L4
	OR			
13 (b)	(i) Explain any two edge linking procedures to assemble edge pixels into meaningful edges. State the advantages and drawbacks.	(7)	CO3	L4
	(ii) Consider the image shown below. Obtain the results of region growing algorithm : $\begin{pmatrix} 1 & 0 & 7 & 8 & 7 & 7 \\ 0 & 1 & 8 & 9 & 8 & 8 \\ 0 & 0 & 7 & 9 & 8 & 8 \\ 0 & 1 & 8 & 8 & 9 & 9 \\ 1 & 2 & 8 & 8 & 9 & 9 \end{pmatrix}$ Assume the seed points are (3, 4) and (5,1). Choose different thresholds to indicate the results:	(6)	CO3	L4

14 (a)	Explain with an example; Gray Level Co-occurrence Matrix method of feature extraction:	(13)	CO4	L3
	OR			
14 (b)	Explain how PCA based feature selection is carried out in an medical image processing application:	(13)	CO4	L3
15 (a)	Consider a 4x8 8-bit image: $\begin{pmatrix} 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \\ 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \\ 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \\ 21 & 21 & 21 & 95 & 169 & 243 & 243 & 243 \end{pmatrix}$ Compress the image using Huffman coding. Also, in general, Differentiate between Arithmetic and Huffman Coding over its advantages and disadvantages:	(13)	CO5	L4
	OR			
15 (b)	How is vector quantization advantageous over scalar quantization? Illustrate with an example.	(13)	CO5	L4

PART- C (1x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	(i) For a given 4×4 image U and 4×4 transformation matrix A, What will be the transformed image V? $A = 1/2 \begin{vmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{vmatrix}$ $U = \begin{vmatrix} 1 & 1 & 1 & 1 \\ 2 & 2 & 2 & 2 \\ 3 & 3 & 3 & 3 \\ 4 & 4 & 4 & 4 \end{vmatrix}$	(8)	CO1	L5
	(ii) Give the conceptual relationship between RGB and HSI color models and illustrate how hue and saturation are obtained from the HSI color model:	(7)	CO1	L5

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