Ref. No.: Ex/IEE/PE/B/T/413A/2024

B. INS. & ELEC. ENGINEERING 4TH YEAR 1ST SEMESTER EXAMINATION 2024

DIGITAL IMAGE PROCESSING

TIME: 3 HOURS **FULL MARKS: 100**

List of Course Outcomes (CO):

CO1: Classify and examine different types of image processing operations in spatial domain (K2, A2)

CO2: Describe and explain the implication of image frequency in processing digital images (K2, A1)

CO3: Describe the popular image processing algorithms and their applications (K2, A1)

CO4: Study the fundamentals of color image processing (K2-understand, A2)

Instructions to the Examinees:

- Each module in the question paper matches up with the corresponding CO
- Attempt **ALL** the questions from **ALL** the modules for the attainment of all the COs
- Alternative questions (if any) exist within a module, not across the modules
- Different parts of same question should be answered together

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MODULE 1

ATTEMPT **ANY FOUR** QUESTIONS FROM THIS MODULE

1.

(a) Mention different applications of digital image processing. Illustrate one such application in detail.

(b) What do you understand by image perception?

(c) Why image compression is required? How is it classified?

(d) How many distinct gray level was there in Bartlane system?

(2+2)+2+(2+1)+1

2.

(a) What do you understand by upsampling an image?

(b) Draw the transfer characteristics of mid-rise quantizer.

(c) Find out the expression of signal to quantization noise ratio of a uniform quantizer.

(d) In light of digital image, explain when non-uniform quantization outperforms uniform quantization.

2+2+4+2

3.

(a) A 3X3 image is rotated by an angle 30° in the clockwise direction. Find out the new pixel location in the rotated image.

(b) What are the essential properties of image interpolation function?

(c) What do you understand by nearest neighbor interpolation? Explain with the help of an example.

4+3+3

4. One 3X3 image has been shown by the matrix $A = \begin{bmatrix} 2 & 3 & 5 \\ 14 & 8 & 6 \\ 11 & 13 & 11 \end{bmatrix}$ where $A(0,0) = 2$. Calculate $A(1.33,1.67)$ using bilinear interpolation and modified bilinear interpolation.

10

5. Write short notes on:
   (a) Mixed connectivity
   (b) Spatial filtering

2X5

MODULE 2

ATTEMPT **ANY TWO** QUESTIONS FROM THIS MODULE

6.
   (a) What do you understand by separable transformation?
   (b) Can 2-D DFT be considered as a separable transformation? Justify your answer.
   (c) For a given 2X2 image U and 2X2 transformation matrix A, find out the transformed image V

$$A = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$U = \begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$$

2+(1+2)+5

7.
   (a) What are the essential properties of basis images?
   (b) Synthesize the expressions for 2-D DFT and IDFT from the notion of basis images.
   (c) Comment on the computational complexity of 2-D DFT.
   (d) One gray level image of size 32X32 may be obtained as a series summation of _____ basis images each of size _____: Fill in the blanks.

2+4+2+2

8. Calculate the transformed image matrices corresponding to the following original matrix

$$U = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

What would happen to the transformed matrices if all the pixels in the original matrix is either 0 or 1? (Assume 0 refers to black and 1 refers to white)

(6+4)

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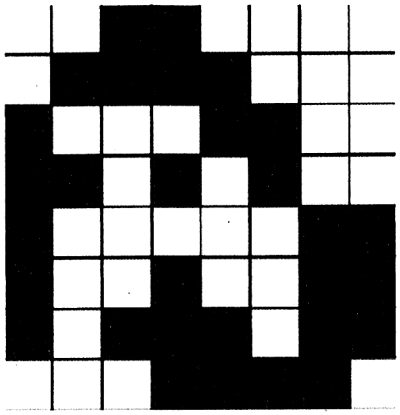
MODULE 3

ATTEMPT **ANY TWO** QUESTIONS FROM THIS MODULE

9.

(a) Write down the steps of connected component labeling algorithm.

(b) Apply this algorithm to mark different regions of the image given below.



5+10

10.

(a) Define Manhattan distance and Chess board distance.

(b) Calculate those distances for a chess board image.

(c) What do you understand by skeletonization?

(d) Mention some of the applications of thresholding operation.

(e) Why contrast enhancement is important?

(2+2)+4+3+2+2

11.

(a) A 5X5 image is shown below:

$$\begin{bmatrix} 1 & 0 & 1 & 4 & 2 \\ 1 & 2 & 3 & 3 & 9 \\ 0 & 1 & 3 & 1 & 8 \\ 1 & 2 & 6 & 5 & 8 \\ 4 & 1 & 7 & 7 & 10 \end{bmatrix}$$

(i) Find out the histogram of the image.

(ii) Apply histogram equalization algorithm on the given image and obtain the equalized image.

(b) What is the advantage of outlier method over median filtering operation? Discuss.

(4+8)+3

MODULE 4

ATTEMPT **ANY ONE** QUESTION FROM THIS MODULE

12.

(a) Draw the RGB color cube and identify different primary and secondary colors on it.

(b) How the intensity value is obtained from RGB color cube?

(c) Consider a red color of varying shades in an image. Comment on hue, saturation and intensity of the color.

(d) Using color mixing approach, identify the primary and secondary colors of pigments.

(e) _____ is used to highlight a specific range of colors in an image to separate objects from surroundings. Choose the correct answer from the options given below:

(i) Color equalization

(ii) Cutting

(iii) Color slicing

(iv) Color enhancement

3+2+2+2+1

13.

(a) Which type of information can be gathered from chromaticity diagram? Explain.

(b) Find out the RGB components of a color pixel specified by its HSI value as 90°, 0.7 & 0.5. Can you comment on the color?

5+(4+1)

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