M.TECH/AEIE/2ND SEM/AEIE 5241/2021

DIGITAL IMAGE PROCESSING
(AEIE 5241)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The quality of a digital image is well determined by
(a) the number of samples (b) the discrete gray levels
(c) both (a) and (b) (d) none of the above

(ii) In digital image of M rows and N columns and L discrete gray levels, the bits required to store a digitized image for $M = N = 32$ and $L = 16$ is
(a) 16384 (b) 4096
(c) 8192 (d) 512

(iii) Dynamic range of imaging system is a ratio where the upper limit is determined by
(a) saturation (b) noise
(c) brightness (d) contrast

(iv) For an 8-bit image $f[m, n]$ the transformation $g[m, n] = 255 - f[m, n]$ will yield a/an
(a) dark image (b) bright image
(c) negative of the input image (d) output image same as the input image

(v) The $D4$-distance between the pixels $(1, 1)$ and $(3, 4)$ is
(a) $\sqrt{13}$ (b) 4
(c) 5 (d) 3

(vi) What is the output of a smoothing, linear spatial filter?
(a) median of pixels (b) maximum of pixels
(c) minimum of pixels (d) average of pixels

(vii) Step edge transition is between pixels over the distance of
(a) 1 pixel (b) 2 pixels
(c) 3 pixels (d) 4 pixels

(viii) Closing is represented by
(a) $A + B$ (b) $A - B$
(c) $A \bullet B$ (d) $A \times B$

(ix) The colour model which is more suitable for printing purposes is the
(a) RGB model (b) CMY model
(c) HSI model (d) YIQ model

(x) Bayes approach to pattern recognition fits into the category of
(a) structural approach (b) statistical approach
(c) template matching (d) neural-network approach

Group – B

2. (a) Define digital image. What are the steps involved in a digital image processing system?

(b) Differentiate between photopic and scotopic vision. Define subjective brightness and brightness adaptation.

(c) Describe HIS color model.

(2 + 2) + (2 + 2) + 4 = 12

3. (a) Compute the 2D Haar transform of the image $f(m,n) = \begin{bmatrix} 4 & -1 \\ 2 & 3 \end{bmatrix}$.

(b) The discrete Fourier transform is performed for the image $f(m,n)$ is given below in Fig. 1. What will be the value of $F(0,0)$?

$$f(m,n) = \begin{bmatrix} 0 & 1 & 2 & 1 & 4 \\ 4 & 1 & 4 & 5 & 6 \\ 1 & 2 & 1 & 0 & 4 \\ 5 & 4 & 1 & 3 & 5 \\ 4 & 2 & 4 & 5 & 6 \end{bmatrix}$$

Fig. 1

(c) Compute the 1-D Walsh basis coefficient $g(n,k) = g(5,3)$ for $N = 8$.

5 + 3 + 4 = 12

Group – C

4. (a) Explain the two categories of image enhancement approaches.

(b) What is image subtraction? State an example where it is useful in practical application.

(c) What is Gaussian filter? Find the output of the 3×3 Gaussian filter when applied on the marked pixel of the following image shown in Fig. 2.

$$f(m,n) = \begin{bmatrix} 2 & 1 & 4 \\ 3 & \boxed{2} & 2 \\ 0 & 4 & 1 \end{bmatrix}$$

Fig. 2

(d) Consider the above image shown in Fig. 2. Apply Laplacian using 4- connectivity and 8-connectivity to find out the outputs of the 3×3 sharpening filter.

2 + 2 + 4 + 4 = 12

5. (a) What is histogram of an image? Explain histogram equalization technique.

(b) Suppose m be the gray level of input image which has to be transformed to output image gray level l by histogram equalization technique. Consider an image of size 64×64 with 8 different gray levels and their distribution is shown in the table 1 below, where n_m is the number of pixels having gray level m. Compute the distribution of the gray levels in the output image obtained by histogram equalization.

Table 1

m	0	1	2	3	4	5	6	7
n_m	123	78	281	417	639	1054	816	688

(2 + 2) + 8 = 12

Group – D

6. (a) Mention the different steps employed in the coding of images using vector quantization.

(b) For the image shown in Fig. 3 below, compute the degree of compression that can be achieved using (i) Huffman coding of pixel values and (ii) run-length coding, assuming 2 bits to represent the pixel value and 2 bits to represent run length.

$$\begin{bmatrix} 3 & 3 & 3 & 2 \\ 2 & 3 & 3 & 3 \\ 3 & 2 & 2 & 2 \\ 2 & 1 & 1 & 0 \end{bmatrix}$$

Fig. 3

(c) Explain the 'fidelity criterion' for lossy image compression.

2 + 8 + 2 = 12

7. (a) Explain transform-based image coding scheme with block diagram.

(b) What are the basic steps involve in JPEG compression? Explain with a block diagram.

(c) Compute the entropy of the image given by $f(m,n) = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 3 \\ 1 & 2 & 2 & 3 \end{bmatrix}$.

4 + 4 + 4 = 12

Group – E

8. (a) Describe the region growing technique for image segmentation and mention the problems associated with it.

   (b) What is meant by object description? Explain 4-chain code descriptor with example.

   (c) What is an edge? Describe Laplacian edge detector.

4 + 4 + 4 = 12

9. (a) What are supervised and unsupervised classification techniques?

   (b) Describe the states involved in k-means clustering.

   (c) Name few measures used as simple descriptors in region description. Define length of a boundary and compactness of a region.

(2 + 2) + 4 + (2 + 2) = 12

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/OTA0NDgxMDIwMzla/a/MzA1ODQ1ODYyNzQ3/details