M.TECH/AEIE/2ND SEM/AEIE 5231/2015
2015

Digital Image Processing
(AEIE 5231)

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 x 1=10**

(i) Which one of the following colour model is used in printing industry?
(a) RGB (b) HSI (c) CMY (d) YIQ.

(ii) Which one of the following is not a geometric transform?
(a) Translation (b) Scaling (c) Rotation (d) Hadamard.

(iii) The number of bits required to store a 256 X 256 image with 32 gray levels is
(a) 65536 (b) 327680 (c) 524288 (d) 2097152.

(iv) The D_4 distance between the pixels (5, 6) and (15, 20) is
(a) 24 (b) 14 (c) 17.2 (d) 10.

(v) Compression ratio of an image is defined by
(a) Original size/Compressed size :1 (b) 1: Original size/Compressed size
(c) Compressed size/ Original size :1 (d) 1: Compressed size/ Original size.

(vi) Huffman coding is used to reduce
(a) Coding redundancy (b) Psycho visual redundancy
(c) Inter pixel redundancy (d) All of the above.

(vii) For line detection we use mask that is
(a) Gaussian (b) Laplacian (c) Ideal (d) Butterworth.

(viii) Dilation followed by erosion is called
(a) opening (b) closing (c) blurring (d) translation.

(ix) The effect of low pass filtering in an image is
(a) contrast enhancement (b) sharpening (c) blurring (d) resizing.

(x) Hue and saturation, both together produce
(a) brightness (b) chromaticity (c) transitivity (d) reflectivity.

Group – B

2.(a) Explain in brief the principle involved in 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. Compute the distribution of the gray levels in the output image according to the rule $\ell = 7c_m$, where c_m is the cumulative probability and n_m is the number of pixels having gray level m.

Table 1

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

2+10=12

3.(a) Write the Hadamard transform matrix H_N for $N = 4$.

(b) Given a 4×4 image in fig. 1, find out its Hadamard transform.

2 0	40	30	50
70	10	50	30
20	70	60	60
10	10	50	60

Fig. 1

2+10=12

Group – C

4.(a) What is the effect of mean filtering to an image?

(b) The fig. 2 below shows a 5×5 image with eight gray levels. Find out the output image obtained by a 3×3 median filter in the spatial domain.

2	0	4	6	3
1	3	6	4	5
4	5	3	7	4
5	5	0	6	5
3	5	7	6	4

Fig. 2

2+10=12

5.(a) What is image segmentation?

(b) Describe the unconstrained image restoration technique.

(c) Write down the conversion formulae from RGB to HSI colour components.

2+5+5=12

Group – D

6.(a) What do you mean by "Edge Detection" in context to Digital Image Processing?

(b) Find a set of code words and average word length using Huffman coding scheme for a set of input gray levels from 0 to 7 with probabilities as given in table 2. Find also compression ratio using Huffman coding and data redundancy of original representation.

Table 2

Gray level	0	1	2	3	4	5	6	7
Probabilities	0.02	0.15	0.03	0.15	0.05	0.20	0.10	0.30

2+10=12

7.(a) Explain the components of an Image Processing System?

(b) Describe, how an image is segmented using the split-and-merge technique in association with the region adjacency graph.

(c) Consider an 8×8 image with gray levels ranging from 0 to 7 shown in fig. 3. Find out the segmented image obtained by split and merge technique considering a threshold value $th = 3$ of the property $\text{Prop}(R)$: $\max_{(r,c)\in R}\{g(r,c)\} - \min_{(r,c)\in R}\{g(r,c)\} \le th$.

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5	6	6	6	7	7	6	6
6	7	6	7	5	5	4	7
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
1	3	2	3	3	2	4	7
0	0	1	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	6

Fig. 3

4+4+4=12

Group – E

8.(a) What is the need for Image Transforms? Is filtering in frequency domain advantageous than in spatial domain?

(b) Sketch the output image in the following cases considering the objects shown in fig. 4.
i) $A \oplus B_1$ and (ii) $A \oplus B_2$

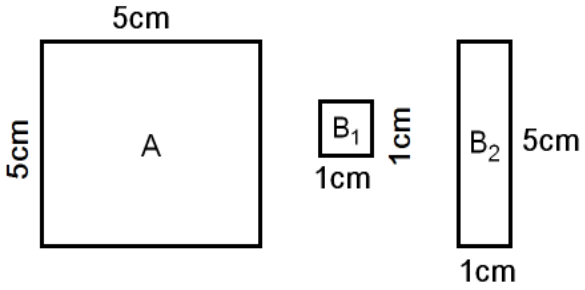

Fig. 4

(4+2)+6=12

9.(a) Define skew, kurtosis and entropy as features of an image.

(b) Suppose in a two-class pattern classification problem classes are represented by mean vector and covariance matrix as given below:

For class I: $\mu_1 = \begin{bmatrix} 20 \\ 30 \end{bmatrix}$, $\Sigma_1 = \begin{bmatrix} 5 & 0 \\ 0 & 10 \end{bmatrix}$

and

For class II: $\mu_2 = \begin{bmatrix} 50 \\ 80 \end{bmatrix}$, $\Sigma_1 = \begin{bmatrix} 8 & 0 \\ 0 & 20 \end{bmatrix}$.

Find discriminating functions between the cases considering Mahalanobis distance.

(c) What is the main difference between cluster-analysis and classification?

3+6+3=12