

Total No. of printed pages = 6

EC 1318 E 032

Roll No. of candidate

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2020

B.Tech. 8th Semester End-Term Examination

DIGITAL IMAGE PROCESSING

(Elective – III)

Full Marks – 50

Time – Two hours

The figures in the margin indicate full marks
for the questions.

Answer Q.No. 1 (any *five*) and any 3 (*three*) from the rest.

1. Answer question the following questions : (5 × 1 = 5)
- (i) If an observer is looking at a tree of 20 m high at a distance of 200 m and the focal length of the eye is 17 mm, then the height of the object in the retinal image
- (a) 2.55 mm
 - (b) 17 mm
 - (c) 20 mm
 - (d) 200 mm

[Turn over

(ii) When you enter a dark theatre on a bright day, it takes an appreciable interval of time before you can see well enough to find an empty seat. Which of the following visual processes is at play in this situation?

- (a) Optical Illusion
- (b) Just Noticeable difference
- (c) Brightness Adaptation
- (d) Simultaneous Contrast

(iii) _____ is the ratio which gives the just noticeable difference ΔI at the background intensity I

(iv) A matrix A is given by

$$A = \begin{bmatrix} 0.4544 & -0.7071 & 0.5418 \\ 0.7662 & 0.0000 & 0.6426 \\ -0.4544 & 0.7071 & 0.5418 \end{bmatrix}$$

Determine whether the matrix is

- (a) Orthogonal
- (b) Unitary
- (c) Toeplitz
- (d) Circulant

(v) _____ are 75-150 millions in number, distributed over the entire retina.

(vi) The process that attempts to reconstruct or recover an image that has been degraded by using a prior knowledge of the degradation phenomenon is called

- (a) Enhancement
- (b) Segmentation
- (c) Restoration
- (d) None of these

- (vii) Gaussian noise is referred to as
- Red noise
 - Black noise
 - White noise
 - Normal Noise
- (viii) Noise reduction is obtained by blurring the image using the smoothing filter.
- True
 - False
- (ix) _____ is a multi-valued logic that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc
- (x) Which of the following transforms are used for compaction of data?
- DCT
 - DFT
 - DWT
 - KL transform

2. (a) (i) Given the following 3-bit image $f(x, y)$, determine the binary images obtained by

$$\text{bit slicing } f(x, y) = \begin{bmatrix} 7 & 3 & 0 \\ 4 & 1 & 6 \\ 2 & 2 & 5 \end{bmatrix}.$$

- (ii) Given the following 3-bit image $f(x, y)$, determine the negative of the image.

$$f(x, y) = \begin{bmatrix} 0 & 1 & 2 \\ 6 & 3 & 4 \\ 7 & 5 & 2 \end{bmatrix}.$$

- (b) Define digital image and digital image processing. What are the fundamental steps of digital image processing?
- (c) Define sampling and quantization. Find the number of bits required to store an 8-bit gray image of size 2048×2048 . (5+5+5=15)
3. (a) Draw the structure of human eye. Differentiate between rods and cones. Do you think that human visual system is inferior to computer vision in some aspects? Justify it. (10+5=15)
- (b) For each of the 5 colour models- RGB, CMYK, HIS, YIQ and YC_bC_r specify an application area where it is suited and a reason why it is more suitable than other models.
4. (a) Compute the two-dimensional DCT coefficient $C(u, v)$ for $u = 1, v = 2$ for the image $f(x, y)$.

$$f(x, y) = \begin{bmatrix} 10 & 10 & 40 & 10 \\ 10 & 10 & 40 & 10 \\ 10 & 10 & 40 & 10 \\ 10 & 10 & 40 & 10 \end{bmatrix}.$$

- (b) Write down the steps involved in JPEG compression standard. (8+7=15)
5. (a) What is image enhancement? Write the basic steps of frequency domain filtering. (5+5+5=15)
- (b) A 3-bit image of size 64×64 has the intensity distribution given below. Find the histogram equalization of this image.

r_k	0	1	2	3	4	5	6	7
n_k	790	1023	850	656	329	245	122	81

- (c) Given a 8-bit gray level image $f(x, y)$ of size 4×4 .

$$f(x, y) = \begin{bmatrix} 200 & 210 & 220 & 210 \\ 210 & 220 & 200 & 210 \\ 220 & 50 & 200 & 200 \\ 250 & 230 & 210 & 220 \end{bmatrix}$$

Let $g(x, y)$ be the image obtained by filtering $f(x, y)$. Calculate $g(2, 2)$ if

- (i) the filter is an averaging filter $h(x, y) =$

$$\begin{bmatrix} \frac{1}{16} & \frac{2}{16} & \frac{1}{16} \\ \frac{2}{16} & \frac{4}{16} & \frac{2}{16} \\ \frac{1}{16} & \frac{2}{16} & \frac{1}{16} \end{bmatrix}.$$

- (ii) the filter is a sharpening filter

$$h(x, y) = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}.$$

- (iii) the filter is a 3×3 median filter.

6. (a) Explain sampling theorem. Show with the help of a figure sampled function under condition of over sampled, critically sampled and under sampled. (5+5+5=15)
- (b) How image restoration is performed using wiener filter? Explain.
- (c) Why we need data compression? Discuss the model of data compression.

7. (a) Construct the Huffman code for the word "COMMITTEE". (8+7=15)
- (b) Explain dilation and erosion. Prove the duality expression.
8. (a) How an image is segmented using region growing techniques? Explain. (8+7=15)
- (b) State the noise model. Express the probability density functions of Gaussian, Erlang and Rayleigh noise.
9. (a) Let p,q be 2 pixels at coordinates (100,200) and (150, 190) respectively. Compute Euclidean distance and chessboard distance. (5+5+5=15)
- (b) Calculate Haar Wavelet transform of the following 4-bit 4×4 image.

$$f(x, y) = \begin{bmatrix} 15 & 13 & 9 & 11 \\ 6 & 7 & 5 & 6 \\ 1 & 4 & 6 & 9 \\ 5 & 7 & 9 & 11 \end{bmatrix}.$$

- (c) Explain the basic model of image restoration.