Total No. of printed pages = 6

# EC 1318E032



Roll No. of candidate.

## 2019

## B.Tech. 8th Semester End-Term Examination

## DIGITAL IMAGE PROCESSING
## (EL-III Departmental)

Full Marks – 100 Time – Three hours

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

Answer Question No. 1 and any *six* from the rest.

$(10 \times 1 = 10)$

1. (i) _____ is a logarithmic function of light intensity. (1)

(ii) The ratio $\frac{\Delta I}{I}$, where $I$ is the intensity of light is called _____. (1)

(iii) The operations _____ and _____ are required to convert analog image to digital image. (1)

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(iv) _____ is to improve the visual quality of the image. (1)

(v) The human visual system has 'eyes' as the _____ hardware. (1)

(vi) _____ is a region in retina with no photoreceptors. (1)

(vii) Mixing of RGB in equal proportion produces _____. (1)

(viii) Hue and saturation taken together is called _____. (1)

(ix) A natural colour will have a single _____. (1)

(x) The straight line connecting red and blue in the chromaticity diagram refers to the _____. (1)

2. (a) Draw the structure of human eye and show the distribution of rods and cones. (10)

(b) An observer is looking at a tree of 20 m high at a distance of 200 m. The focal length of the eye is 17 mm. What is the height of the retinal image? (5)

3. (a) For the image find the Euclidean, city blocking and chessboard distance. (6)

$f(x,y)=$

| | | |
|---|---|---|
| 0 | 0 | 0 ($p$) |
| 0 | 1 | 2 |
| 3 ($q$) | 2 | 1 |

(b) What is a pixel? Define neighbourhood pixel $N_4(p)$, $N_D(p)$ and $N_8(p)$. (4)

(c) What is the difference between full colour processing and pseudo-colour processing? Describe any one colour model in brief. (1 + 4 = 5)



4. (a) Discuss the properties of 2D-DFT. (5)

(b) Why do we use Fourier Transform? Check whether the DFT matrix is unitary or not. (1 + 4 = 5)

(c) Given $f(x,y)=\begin{bmatrix}1 & 2 & 1\\ 2 & 3 & 3\\ 1 & 1 & 2\end{bmatrix}$. If $F(u,v)$ is the 2D-DFT of $(x,y)$, calculate $F(1,1)$. (5)

5. (a) If $A$ is a DCT matrix of order 2, show that $A$ is orthogonal. (4)

(b) Compute DCT and IDCT for the $2 \times 2$ image $f = \begin{bmatrix} 20 & 13 \\ 20 & 1 \end{bmatrix}$. (5)

(c) For the image $f(x,y) = \begin{bmatrix} 0 & 1 & 2 \\ 6 & 3 & 4 \\ 7 & 5 & 2 \end{bmatrix}$. Determine the negative of the image. (3)

(d) Resize the image to a $4 \times 4$ image $f(x,y) = \begin{bmatrix} 10 & 7 \\ 15 & 9 \end{bmatrix}$. (3)

6. (a) What are the image enhancement techniques? Explain any one in brief. (5)

(b) Perform Histogram equalisation of the following image $f(x,y) = \begin{bmatrix} 0 & 1 & 2 & 3 \\ 2 & 3 & 4 & 6 \\ 1 & 3 & 1 & 7 \\ 4 & 5 & 1 & 5 \end{bmatrix}$. Write the expressions and draw the PDF and CDF of the histogram equalised image. (10)

7. (a) Calculate Haar Transform of the following 4-bit image $f(x,y) = \begin{bmatrix} 11 & 9 & 13 & 15 \\ 6 & 7 & 4 & 6 \\ 4 & 1 & 11 & 6 \\ 5 & 11 & 9 & 7 \end{bmatrix}$. (5)

(b) For the given 8-bit image of size $4 \times 4$ $f(x,y) = \begin{bmatrix} 210 & 220 & 230 & 250 \\ 220 & 200 & 210 & 240 \\ 200 & 50 & 220 & 200 \\ 250 & 210 & 230 & 220 \end{bmatrix}$. Find the filtered image $g(x,y)$ if the :

(i) filter is a $3 \times 3$ medial filtere

(ii) filter is an average filter with mask $h(x,y) = \begin{bmatrix} 1/16 & 2/16 & 1/16 \\ 2/16 & 4/16 & 2/16 \\ 1/16 & 2/16 & 1/16 \end{bmatrix}$. (5 + 5 = 10)

8. (a) Draw and explain the model of image degration/restoration. (5)

(b) What is the need of image compression? Explain any one compression standard in brief. (1 + 4 = 5)

(c) Obtain Huffman code for the word 'COMMITTEE'. Also find the average code length. (5)

9. (a) What are the types of edge? Apply split and merge procedure to segment $f(x, y)$ based on equal intensity criteria. (2 + 8)

$$f(x,y) = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 10 & 10 & 0 & 0 \\ 0 & 0 & 0 & 0 & 10 & 10 & 0 & 0 \\ 0 & 0 & 10 & 10 & 10 & 10 & 0 & 0 \\ 0 & 0 & 10 & 10 & 10 & 10 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}.$$

(b) What is image morphology? Write in details the dilation and erosion operations. Also describe the opening and closing operations. (1 + 2 + 2)