THE LNM INSTITUTE OF INFORMATON TECHNOLOGY
ENDTERM - IMAGE PROCESSING (2017-18, II)

Maximum Marks: 100

TIME: 3 hours

Write answers in sequence of questions.

Q1. Fill in the blanks with respect to a Canny filter:

First convolve the image with a __(a)__ filter. Compute the __(b)__ of the resultant smooth image. To thin the edges, we apply the __(c)__ process. Then, __(d)__ thresholding is done which uses two thresholds. The gaps are bridged using the edge points in the __(e)__ threshold image.   (5)

Q2. For the digits 0 and 1, compute the Euler numbers   (5)

Q3. Generate Laplacian of Gaussian where $G(x,y) = \dfrac{1}{2\pi\sigma^2} e^{\frac{-(x^2+y^2)}{2\sigma^2}}$ (5)

Q4. Consider a one-dimensional image $f(x) = 60\ 60\ 60\ 100\ 100\ 100$. What are the first and second derivatives? How are you able to detect presence of an edge from these derivatives?   (2+2+1+1=6)

Q5. Consider image I and structuring elements S1 and S2.

I

0	0	0	0	0	0
0	0	1	1	1	0
0	1	1	1	1	0
0	1	1	1	1	0
0	0	1	1	0	0
0	0	0	0	0	0

S1

	1	
1	1	1
	1	

S2

1	1	1

a) Which morphological operation can be applied to the image I using the given structuring element S1 to extract the boundary of the image? Show how.   (1+4=5)

b) Show (I dilated by S2)   (4)

c) Draw a structuring element S3 which will extract the top right corner of the image.   (3)

d) Show reflection of S3.   (3)

Q6. For the 2D-DFT $F(u,v)$ of an image, $f(x,y)$ given below, generate $F(1,1)$. What does the component $F(0,0)$ denote and what is its value?   (6+1+2 = 9)

$$f(x,y) = \begin{array}{c} \text{X} \rightarrow \\ \text{Y} \downarrow \end{array} \begin{array}{|c|c|} \hline 24 & 34 \\ \hline 23 & 12 \\ \hline \end{array}$$

Q7. Consider an 8x8 image composed of a checkerboard of alternating 1s and 0s. Assume that top left pixel has value 0.

a) Obtain the gray level co-occurence matrix using the position vector "two pixels to the right". (6)

b) Give the quad-tree representation of the image. (5)

Q8. Consider the RGB image comprising of four parts.

| Pure Red	Light Pink
White	Navy

a) Draw the saturation image for the RGB image (Use white, light gray, dark gray, black etc. to denote saturation values) (1.5*4=6)

b) Is the given hue image correct? If not, why? Show corrected image. (4)

0	350
undefined	40

Q9. Consider the image below with a unit distance grid:

a) Compute the shape number of the image using 8-connectivity. What is the order of the shape number? (4+1=5)

b) Assuming city-block distance measure, what is the diameter of the object? Also, draw the major axis. (3+2=5)

c) Taking Euclidean distance as a measure, what is the perimeter of the object? (4)
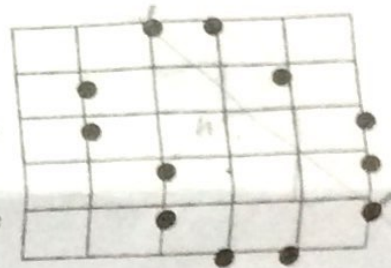
Q10. Consider the image I shown below.

20	22	21	25
22	200	22	25
22	20	2	30
22	25	25	30

a) Label any salt-and-pepper noise seen in the image? How can it be removed (assume boundary pixels are not processed)? Show the denoised image. (2+1+5 = 8)

b) Consider the denoised image obtained in part (a) which is thresholded using a global threshold. Threshold is the average (floor) of maximum and minimum values (pixels at threshold value are considered foreground). Show the thresholded image. (4)

c) For the denoised image obtained in part (a), apply adaptive thresholding. Threshold for each region is computed as in (b). Show the thresholded image. (8)