MASTER OF E.T.C.E., 2ND SEMESTER EXAM, 2017

DIGITAL IMAGE PROCESSING

Time: 3 Hours | Full Marks: 100

Answer **any Five** Questions.

(Answers to **all parts** of a Question must be written at **one place**.)

1. a) What is histogram of an image? 4+6

   After histogram equalization has already been applied to a digital image show that results will not vary if histogram equalization is again applied to that image.

   b) An image is blurred by using a 3x3 averaging mask and then its histogram is obtained. Explain how the histogram will change? 5+5

   Why does a 3x3 Laplacian mask with -8 at its centre produces sharper results than with -4 at its centre?

2. a) In a given application an averaging mask is applied to input images to reduce noise, and then a Laplacian mask is applied to enhance small details. What would happen if the two operations are reversed. 10

   b) Two images f(x,y) and g(x,y) have histograms h_f and h_g. Give the conditions under which you can determine the histograms of 10

   (a) f(x,y) + g(x,y)

   (b) f(x,y) - g(x,y)

   (c) f(x,y) x g(x,y)

   (d) f(x,y) / g(x,y)

   Explain how to obtain the histogram in each case.

3. a) Show that both the forward and inverse discrete transforms are infinitely periodic with period M, F(u)=F(u+kM) and f(x)= f(x+kM) . 10

   b) Write an expression for 2D continuous convolution. Prove that both the 2 D continuous and discrete Fourier Transform are linear operations. 2+8

4. a) Explain why a mean filter belongs to the class of linear spatial filter? What is the importance of mean filter? Discuss one frequency domain filter which does the same work as a mean filter. State its transfer function. 3+2+5

   b) Apply a mean filter and a max filter on the following image. Use a 3x3 neighbourhood. 10

5	1	2	6	7
4	4	7	5	8
2	6	20	6	7
3	1	2	4	5
10	2	1	2	3

5. a) Explain why an image filtered with a geometric mean filter is less blurred than when filtered with an arithmetic mean filter of same size? 6+4

Why do the dark components become thicker in the case of using the geometric mean filter.

b) Find the equivalent filter H(u,v) that implements in the frequency domain the spatial operation performed by the Laplacian mask as shown 10

0	1	0
1	-4	1
0	1	0

6. a) Can a variable length coding procedure be used to compress a histogram equalized image with 2^n intensity levels? Explain. 10

b) Given a four-symbol source {a,b,c,d} with source probabilities {0.1,0.4,0.3,0.2}, arithmetically encode the sequence *bbadc.* 10

7. a) Propose a technique for detecting gaps of length ranging between 1 and k pixels in line segments of a binary image. Assume that the lines are 1 pixel thick. 10

b) What is a Sobel mask? Show why the coefficients of this mask are suitable for detecting edges in an image. Hence show that the edges so detected are useful in image segmentation. 2+4+4

8. a) With reference to this equation $\nabla 2h(r)=-[(r2-\sigma 2)/\sigma 4]\, e-r/2\sigma$ 5+5

(i) Show that the average value of the Laplacian operator $\nabla 2h$ is zero.

(ii) Prove that the average value of any image convolved with this operator also is zero.

b) Restate the basic global thresholding algorithm so that it uses the histogram of an image instead of the image itself. 10