Ref. No.:Ex/PG/ETCE/T/128B/2018

MASTER OF E.T.C.E., 2ND SEMESTER EXAM, 2018

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) Sketch a family of transformations as a function of parameter E, for a fixed value m=L/2, here L is the number of intensity levels in the image. 10

   b) Why the discrete histogram equalization technique does not yield a flat histogram in general? 5

   c) Discuss the limiting effect of repeatedly applying a 3x3 low pass spatial filter to a digital image. Ignore border effects. 5

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) Consider a checkerboard image in which each image is 1x1 mm. Assuming that the image extends infinitely in both coordinate directions, what is the minimum sampling rate (in samples/mm) required to avoid aliasing? 10

3. a) Show that if a filter transfer function H(u,v) is real and symmetric, then the corresponding spatial filter h(x,y) is also real and symmetric. 10

   b) Write an expression for 2D continuous convolution. Prove that both the 2 D continuous and discrete Fourier Transform are linear operations. 10

4. a) During acquisition, an image undergoes uniform linear motion in the vertical direction for a time T_1. The direction of motion then switches to the horizontal direction for time interval T_2.Assuming that the time taken for the image to change directions is negligible, and that the shutter opening and closing times are negligible too, give an expression for the blurring function, H(u,v). 10

b) Obtain equations for the band pass filters corresponding to the band reject filter 10

$$H(u,v) = \begin{cases} 0, -\frac{W}{2} \leq D \leq D_0 + w/2 \\ 1, otherwise \end{cases} \qquad Ideal$$

$$H(u,v) = \frac{1}{(1 + [\frac{DW}{D^2} - D_0^2]^{2n}} \qquad Butterwoth$$

$$H(u,v) = 1 - e^{-\left[\frac{D^2 - D_0^2}{DW}\right]^2} \qquad Gaussian$$

5. a) Consider a linear position invariant image degradation system with impulse response 10

$$h(x-\propto, y - \beta) = e^{-[(x-\propto)^2 + (y-\beta)^2]}$$

Suppose that the input to the system is an image consisting of a line of infinitesimal width located at $x=\alpha$, and modeled by $f(x,y)=\delta(x-\alpha)$, where δ is an impulse . Assuming no noise , what is the output image $g(x,y)$?

b) What do you mean by data compression? Define coding redundancy and compression ratio. 10

6. a) Can variable length coding procedures be used to compress a histogram equalized image with 2n intensity levels? Explain. 2+8

b) The arithmetic decoding process is the reverse of encoding. Decode the message 0.23355, given 10

Symbol	Probability
a	0.2
e	0.3
i	0.1
o	0.2
u	0.1
!	0.1

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) Compare the LoG edge detector and Canny edge detector operator. 10

b) Is the threshold obtained with the basic global thresholding independent of the starting point? If yes, prove it. If no, give an example. 10