

Major
ELL715 (2018-19)
Digital Image Processing

• One more paper for 30mins at 5 PM.

Max. Marks: 100

1. The histogram of a 3-bit, 12×7 image $f(x, y)$ is described by the function,

$$h(n) = n(8 - n); 0 \leq n \leq 7$$

Evaluate: $\sum_u \sum_v |F(u, v)|^2$.

10

2. An imaging system has a spatially invariant impulse response function,

$$h(x, y) = Ke^{-(x^2+y^2)}$$

An input image $f(x, y)$ to the system is a vertical line located at $x = a$.
Compute and sketch the output.

10

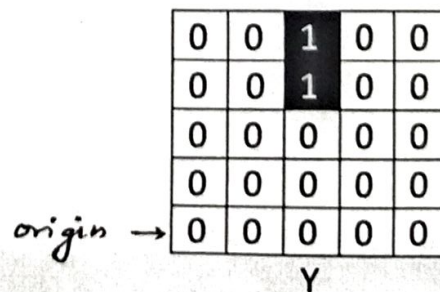
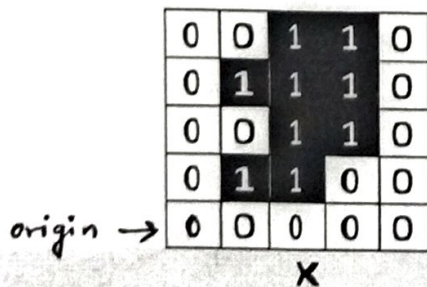
3. A digital image $p_r(r)$ is subjected to histogram equalization 'N' number of times. Relate the output of i^{th} pass ($i \geq 2$) of histogram equalization to $(i-1)^{\text{th}}$ pass for all values of i , where, $i \leq N$.

5

4. Determine the radon transform when $f(x, y) = \exp(-x^2 - y^2)$.

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5. Design an appropriate structuring element such that Y can be obtained after applying certain morphology to X. (assume black for 1 and white for 0)



10

(Assume zero padding)

Hint: Structuring element is of size (2×2) .

6. Consider the given gray-scale image matrix (A) and non-flat structuring element (B) (with origin shown in gray color), Evaluate

3	5	7
3	4	7
8	6	5

A

2	2
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B

- Eroding A with B
- Dilating A with B
- Opening A with B

15

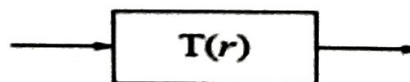
7. Given a 3 bit image of size 4x4, passes through an intensity transformation function given by:

$$s = T(r) = \alpha \log_2(1 + r) + \beta$$

where, α and β are constants. A few pixels are available in the input and output images, as shown below. What are the values of the pixels 'A' and 'B' in the input and output images respectively?

	3		3
9		15	
	A		
1			3

input image



	5		5
		11	9
3	8		
B	9		5

output image

10

8. For the input image

30



Please mention the correct operation to obtain the corresponding output given in the table. Also, justify it. Operations may be from the following,

- Difference between closing and original image (using a ball shaped structuring element).
- Gaussian Low pass filter
- Grayscale erosion: using a ball shaped structuring element
- Antilog
- Difference between original image and its opening (using a ball shaped structuring element).
- Motion blur
- Laplacian of gradient
- High boost filter
- Log
- Sobel operator
- Laplacian of Gaussian
- Histogram equalization
- Negative of original image