Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER III (NEW) – EXAMINATION – WINTER-2016

Subject Code: 2730303 **Date:25/10/2016**

Subject Name: Image Processing for Instrumentation

Time:02:30 pm to 05:00 pm **Total Marks: 70**

Instructions:

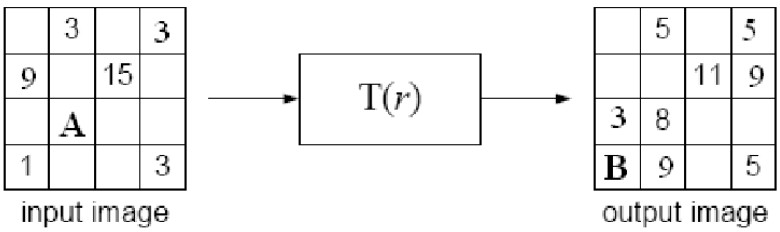
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **All symbols carry their usual meaning unless otherwise stated.**

Q.1 **(a)** Morphological structuring element (s.e.) of size 3x3 of all 1's is applied on a 2-pixel thick 'H', depicted in the following image. Show the result of (i) dilation, (ii) erosion, and (iii) thinning of 'H' (1-pixel). Discuss in brief all your steps required for solutions in algorithms. Consider middle pixel of s.e. as origin. **07**

	1	1					1	1	
	1	1					1	1	
	1	1					1	1	
	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	
	1	1					1	1	
	1	1					1	1	
	1	1					1	1	

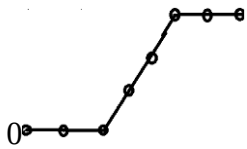
(b) Given an image of size 4x4, 4- bits passes through an intensity transformation function given by: $s = T(r) = \alpha \log_2(1+r) + \beta$ **07**

Where α and β are constants, 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?

Q.2 **(a)** Write an image segment of size 8x8 which has a gray level profile across any of the horizontal scan line as shown below (minimum to maximum gray level), in which small circles show sampling points. Assume 5-bit image. Draw second order derivative along any one horizontal scan line of your image. **07**



(b) Draw histogram of the following 5x5 image segment. Modify the histogram of this image as per Table A shown below and show image segment for the same. **07**

0	0	1	1	2
0	1	1	2	2
1	1	2	3	1
1	2	3	1	1
2	3	1	0	0

Table A: Desired histogram

Gray level f	0	1	2	3
Histogram h(f)	15/25	0	0	10/25

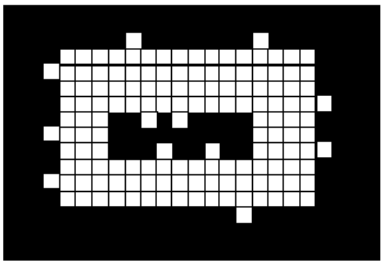
OR

(b) With the help of figures and equations discuss the role of illumination in histogram distortion. **07**

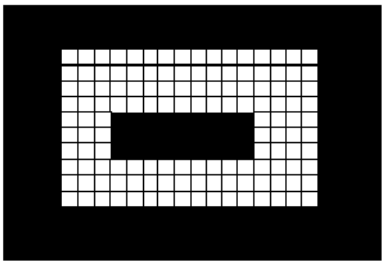
Q.3 **(a)** An image segment is show below. Let V be the set of gray level values used to define connectivity in the image. Compute D4, D8 and Dm distances between pixel p and q for (a) v = { 0,1}, (b) v = {1,2}. **07**

	3	1	2	1 q
	2	2	0	2
	1	2	1	1
p	1	0	1	2

(b) Propose a morphological procedure to clear the edge artifacts of the image given in (a) such that the image in (b) is obtained. Clearly state the structuring element(s) and number of iterations that you would use in your procedure. **07**



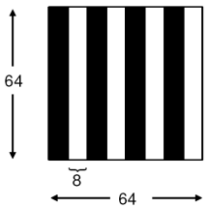
(a)



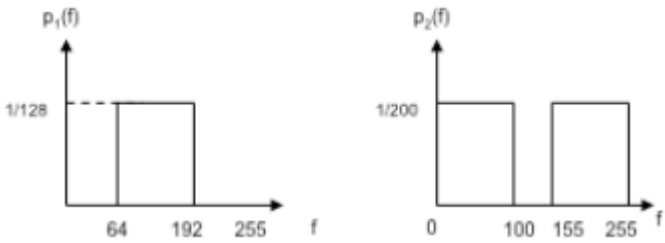
(b)

OR

Q.3 **(a)** Given a 64x64 image of black (0) and white (255) vertical stripes (each strip is of width 8 pixels). Spatial filtering is performed using averaging kernel of size 3x3. What will be the effect of this kernel on filtered image and its histograms? Show kernel and histograms of original as well as filtered image. **07**



(b) The histograms of two images are shown below. Sketch a transformation function for each image that will make the image has a better contrast. **07**



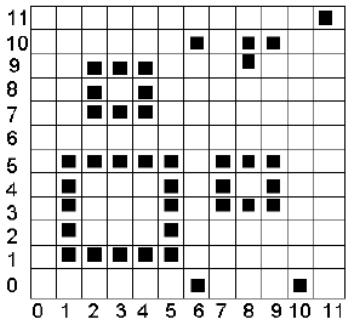
Q.4 **(a)** Given a 5x5 pixel image and respective pixel values (8-bit code for each pixel) below, (i) Calculate the respective Huffman codes for each symbol (each pixel value) of the given image, (ii) What is the compression ratio achieved by employing Huffman coding instead of 8-bit fixed length coding? **07**

180 160 160 140 120
110 110 120 140 120
110 140 120 120 140
120 160 160 170 170
170 120 110 140 110

(b) With the help of necessary expressions and figures discuss morphological thinning algorithm. **07**

OR

Q.4 **(a)** In the Hough Transform, a point (x0, y0) in the xy-plane is mapped into a curve in the (ρ, θ) parameter space. Write down the equation of the curve. If we apply the Hough transform on the image below, what would be the maximum value for the accumulator cell in the (ρ, θ) space? What is the corresponding (ρ, θ) value? Give justification of your answer. Each black square denotes a point and the numbers are the coordinates, in figure. **07**



(b) Consider 5x4, 8-bit image segment shown below. Construct the dictionary for LZW coding. **07**

50	50	212	212
50	50	212	212
50	50	212	212
30	30	212	212
30	30	212	212

Q.5 **(a)** Define grayscale erosion. For the image segment of size 4x4 and operator of size 3x3 shown below, find grayscale erosion output and show it in the image segment form. **07**

7	6	3	4
5	6	6	8
6	4	5	2
6	4	2	3

1	1	1
1	5	1
1	1	1

(b) What do you mean by separable property of DFT? Explain the same with mathematical expression and figure. **07**

OR

Q.5 **(a)** Define grayscale dilation. For the image segment of size 4x4 and operator of size 3x3 shown below, find grayscale dilation output and show it in the image segment form. **07**

7	6	3	4
5	6	6	8
6	4	5	2
6	4	2	3

2	2	2
2	4	2
2	2	2

(b) With the help of necessary equations explain translation property of the 2-D Fourier transform. With the help of necessary figure(s) show the use of this property in image processing. **07**

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