Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. - SEMESTER – VIII EXAMINATION – OCTOBER 2012

Subject Code: 181102 Date: 25/10/2012

Subject Name: Fundamental of Image Processing

Time: 02.30pm - 05.00pm Total Marks: 70

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain sampling, quantization and bit-planes of gray scale images with examples. **07**

(b) Sketch a piece-wise linear input-output characteristic with the corner points (0, 0), (100, 30), (200, 230), and (255, 255). Determine the output for the following input. **07**

20	40	60
80	100	120
140	160	200

Image I: Q.1 (b).

Q.2 **(a)** Explain implementation of Laplacian operator in 2D space and in 2D spectrum. State an application of Laplacian. **07**

(b) Segment the following image into two regions, clearly depicting the boundary based on the histogram. **07**

3	2	0	8	7
2	3	1	8	7
2	2	1	8	7
7	7	7	8	8
6	6	6	6	5

Image II: Q.2 (b)

OR

(b) Explain motivation and implementation of homomorphic filter approach for image enhancement. **07**

Q.3 **(a)** Explain extension of 1D DFT to 2D DFT. Sketch a typical MxN point DFT to depict low and high frequencies. **07**

(b) Explain Butterworth low-pass and high-pass frequency responses and their implementation in 2D spectral domain. **07**

OR

Q.3 **(a)** Explain 2D wavelet analysis structure. Derive 2-level wavelet analysis of the following image with the subband filters $h_0[n]=\{1,1\}$ and $h_1[n]=\{1,-1\}$. **07**

4	5	3	2
5	6	4	1
3	2	4	2
2	3	2	3

Image III: Q.3 (a) and Q.3 (b).

(b) Derive Huffman code for encoding the gray-levels in **07**

Image III given above and the compression ratio for the same.

Q.4 **(a)** Explain each of the three characteristics of AWGN (Additive White Gaussian Noise) model. **07**

(b) Explain RGB and CMY color models. Derive a CMY equivalent of a 24-bits RGB vector (55, 100, 165). **07**

OR

Q.4 **(a)** Derive the relation between the reduction in noise and the number of observations K in an averaging method where K degraded image observations due to an additive noise with zero mean and a constant variance are averaged. **07**

Q.4 **(b)** Explain color complements in RGB and HSI color spaces. Derive the color complement of RGB vector (0.5, 0.1, 0.2) on the elementary color scales of [0, 1]. **07**

Q.5 **(a)** Explain Erosion, Dilation, Opening and Closing. Give appropriate morphological operations on a 2-pixel thick 'H', depicted in the following image for (i) removing the horizontal segment of 'H', (ii) removing the vertical segments of 'H', and (iii) thinning of 'H' to 1-pixel. **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	

Image IV: Q.5 (a).

(b) Segment the following image into two regions based on the edge-orientations derived through a gradient operator clearly depicting the boundary. **07**

27	27	27	27	27
25	25	25	25	25
23	23	30	33	36
21	21	33	36	39
19	19	36	39	42

Image V: Q.5 (b).

OR

Q.5 **(a)** Explain a linear image-degradation model, an inverse restoration filter and its limitations. **07**

(b) Give a morphological approach to detect 3x3 size patches of white color in a color image in RGB space. **07**

****