Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 714104 **Date: 24-06-2014**

Subject Name: Digital Image Processing and Applications

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

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full mark.**

Q.1 **(a)** Answer the following Questions (ANY SEVEN) **07**

1. Explain 8-connectivity of pixel with suitable example.
2. Define D4-Distance between two pixels P and Q of coordinates (x,y) and (s,t) respectively.
3. Show that an edge spatial filter is equivalent to subtracting the original image from its smoothed image.
4. Compare median filtering and a low pass filtering on a noisy image. Which performs best (i.e. removal of most noise with least blurring)? How?
5. Explain Rayleigh noise. Also mention its mean and variance with respect to the gray level of an image.
6. Draw the *sobel* masks for the edge detection.
7. Why does histogram equalization (discrete histogram equalization) not produce a perfect flat histogram?
8. What are the two conditions that a transformation has to satisfy?
9. A squared image needs a memory of 1,47,456 bytes when it is quantized with an 8-bit ADC. What will be the memory required had the same image decimated to half its original size quantized with a 10-bit ADC?

(b) Given Figure 1 below is a 3X3 image. What will the value of the centre pixel change to when this image is passed through a **07**

(i) Arithmetic mean filter.
(ii) Geometric mean filter.
(iii) Harmonic mean filter.
(iv) Min filter.

1	7	5
6	2	3
1	4	2

Figure 1: 3 X 3 image

Q.2 **(a)** Apply Histogram Equalization technique on the image shown in Figure 2. Show the resultant equalized image and its histogram. **07**

1	1	2	2	3	3	8	8
1	1	1	2	2	3	3	8
2	1	1	1	2	3	3	8
2	2	1	1	1	2	2	3
3	2	2	1	1	1	2	3
3	3	2	2	1	1	1	2
8	3	3	2	2	1	1	1
8	8	3	3	2	2	1	1

Figure 2: 8 X 8 image segment

(b) Prove that $D(P, Q) = \exp\left(-2\left(\frac{(x-s)^2}{\sigma^2} + \frac{(y-t)^2}{\sigma^2}\right)\right) = D(P, R) - D(R, Q)$. **07**

OR

(b) List down different types of noises, which can be found in an image. How can **07**

we estimate mean and the variance of a noisy image? Explain Inverse Filtering in detail with suitable equations.

Q.3 **(a)** The basic approach used to approximate a discrete derivative involves taking difference of the form *f(x+1,y)-f(x,y).* **07**

1. Obtain the filter transfer function, H(u,v) for performing the equivalent process in the frequency domain.
2. Show that H(u,v) is a high pass filter.

(b) Apply Box filter mask of the size 3X 3 on the image shown in figure 3 below. Conclude about the result. **07**

3	3	8	3	3
3	8	6	8	3
8	5	5	5	8
3	8	6	8	3
3	3	8	3	3

Figure 3: 5X5 image

OR

Q.3 **(a)** Explain the steps involved in filtering the image in frequency domain. **07**

(b) Explain homomorphic filtering in detail. **07**

Q.4 **(a)** Explain the Morphological thinning and thickening operations with suitable mathematical equations. **07**

(b) Apply the prewitt mask of the size 3 x 3 on the image shown in Figure 4 below. Conclude about the result. **07**

3	3	8	3	3
3	8	6	8	3
8	5	5	5	8
3	8	6	8	3
3	3	8	3	3

Figure 4: image segment of 3 X 3

OR

Q.4 **(a)** The input binary image X, is shown in Figure 5, the image X is eroded with the structuring element B . Show the resultant image. **07**

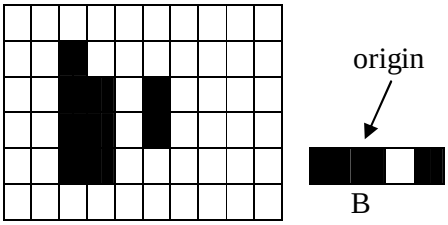

Figure 5: 10 X 10 image segment, 1X4 structuring element

(b) Write a short note on optimum Global Threshold using Otsuôs method. **07**

Q.5 **(a)** List out the applications of morphological operations in the field of image processing in detail. **07**

(b) Compare the *canny* edge detector with the *Laplacian of Gaussian* edge detector. **07**

OR

Q.5 **(a)** Write a short note on image segmentation using split and merge algorithm. Apply the split-and-merge technique for the given image shown in Figure 6. **07**

1	1	1	1	1	1	1	1

1	1	1	0	0	1	1	1
1	1	0	1	1	0	1	1
1	1	0	1	1	1	1	1
1	1	1	0	0	1	1	1
1	1	1	1	1	0	1	1
1	1	0	1	1	0	1	1
1	1	1	0	0	1	1	1

Figure 6: 8X8 image

(b) Explain the steps involved in Face Recognition System. Explain each and every steps in detail with suitable equations. **07**

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