Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –I Examination Feb. - 2012

Subject code: 714104N **Date: 21/02/2012**
Subject Name: Digital Image Processing and Applications
Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** Define D4-, D8- and Dm- distance between two points *p* and *q* with coordinates *(x,y)* and *(s,t)*. For the image segment shown in Figure 1, compute the D4-, D8- and Dm-distances between pixels *p* and *q* for *V={1,2}*. **07**

	3	1	2	1	*(q)*
	2	2	0	2	
	1	2	1	1	
(p)	1	0	1	2	

Figure 1: Image segment of 4 X 4

(b) The image shown in Figure 2 is corrupted by salt and pepper noise. Apply arithmetic mean and median filter to remove the noise. Compare the results. **07**

80	80	80	10	10	80	80
70	255	70	10	10	70	70
70	70	70	10	10	70	70
50	50	50	00	10	255	50
60	255	60	10	10	60	60
60	60	60	10	00	60	60
80	80	80	80	80	80	80

Figure 2: Image segment of 7 X 7

Q.2 **(a)** Differentiate between image restoration and image enhancement. Explain inverse filtering method. Discuss the drawback and its solution of inverse filtering method. **07**

(b) Explain Histogram Equalization Technique in detail with suitable derivatives. Suppose *"m"* be the gray level of the input image which has to be transformed to output image gray level *"l"* by histogram equalization technique. For an 8-level image of size 8X8, we have the following frequency table for the input gray levels. **07**

Gray level *(m)*	0	1	2	3	4	5	6	7
Occurrence (n_m)	14	6	6	6	6	6	6	14

Apply the histogram equalization on this image. Also plot the equalized histogram of the output image.

OR

(b) Explain unsharp masking and high boost filtering in detail with suitable example. **07**

Q.3 **(a)** Explain Gaussian low-pass filtering in frequency domain. Also discuss several practical applications of low-pass filtering in the frequency domain. **07**

(b) What is an "edge" in an image? What is the difference between an "edge" and a "line" in an image? Explain simple Hough Transform technique of line detection. **07**

OR

Q.3 **(a)** A person wishes to apply the Laplacian-of-a-Gaussian edge operator to an image *f(m,n)* of size 256 X 256. The size of the edge operator (mask) is 32 X 32 and origin is at its centre. Describe in words how to perform the operation in frequency domain. **07**

(b) Explain region splitting and merging technique for image segmentation. Apply the split-and-merge technique for the given image shown in Figure 3. **07**

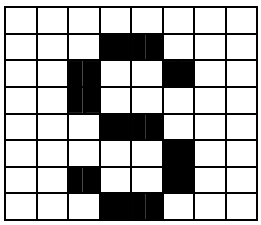
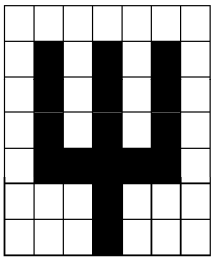


Figure 3: Image segment of 8X 8

Q.4 **(a)** Define the basic morphological operation "dilation" for a binary image. Using the input image shown in Figure 4 and structuring element shown in Figure 5, find the dilated version of the input image. **07**



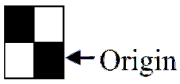


Figure 4: Image segment ,Figure 5: Structuring element

(b) Explain the morphological opening and closing in detail with suitable example. **07**

OR

Q.4 **(a)** Explain the basic Morphological Algorithms: (1) Boundary Extraction and
(2) Hole filling in detail. **07**

(b) For the image as shown in Figure 6, make use of region filling to fill up the image. **07**

The structuring element is also shown in Figure 7. Note that here the shaded portions are considered as value "1". The origin of the structuring element is denoted as "*".

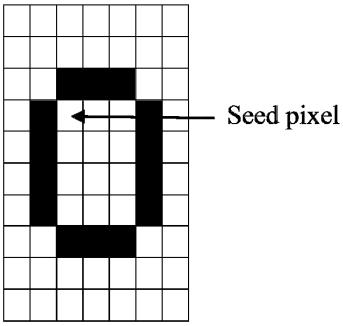


Figure 6: Image segment, Figure 7: Structuring Element

Q.5 **(a)** Explain the optimum global thresholding using Otsu's method in detail with suitable derivations. **07**

(b) A company that bottles a variety of industrial chemicals has heard of your success solving imaging problems and hires you to design an approach for detecting then bottles are not full. The bottles appear as shown in Figure 8 as they move along a conveyor line past an automatic filling and capping station. A bottle is considered imperfectly filled when the level of the liquid is below the midway point between the bottom of the neck and the shoulder of the bottle. The shoulder is defined as the region of the bottle where the sides and slanted portion of the bottle intersect. The bottles are moving but the company has an imaging system equipped with an illumination flash front end that effectively stops motion, so you will be given images that look very close to the sample shown here. Based on the material you have learned, propose a solution for detecting bottles that are not filled properly. State clearly all assumptions that you make and that are likely to impact the solution you propose. **07**

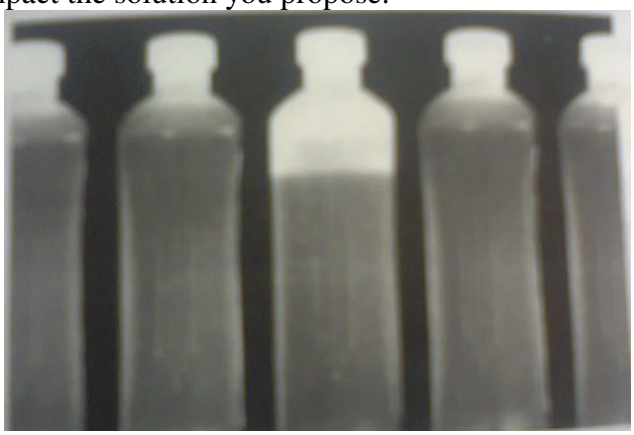


Figure 8

OR

Q.5 **(a)** State the application fields of object recognition. As a case study explain the face recognition system, classifications and challenges in face recognition system. **07**

(b) List out various applications of Digital Image Processing. Explain one application in detail. **07**

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