Roll No. ....

EC–8301, EI–8402 & EX–8403

B. E. (Eighth Semester) EXAMINATION, June, 2009

(Common for EC, EI & EX Engg.)

DIGITAL IMAGE PROCESSING

(Elective – III & IV)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note :   Answer any *five* questions. All questions carry equal marks.

1. (a) Discuss the two-dimensional sampling theorem. Explain the Nyquist rate, aliasing and foldover frequencies.   10

   (b) Suppose intensity distribution of an image is given by :

   $$f(x, y) = A + A \cos \pi (3x + 4y)$$

   for $x_{min} \leq x \leq x_{max}$ and $y_{min} \leq y \leq y_{max}$. Determine the least sampling frequency enabling reconstruction.

   10

2. (a) Define one-dimensional Fourier transform pair. Prove that imaginary part of Fourier transform of an even function is zero.   10

   (b) For the 2 × 4 image :   10

   $$\begin{bmatrix} 1 & 2 & 5 & 6 \\ 3 & 4 & 7 & 8 \end{bmatrix}$$

   compute the Hadamard transform.

3. (a) Explain the concept of median filtering and discuss its properties and limitations.   10

   (b) An 8-bit input image has to be enhanced by stretching graylevel range [96, 169] by a factor of 2. The remaining parts of the gray scale should be compressed at a uniform rate. Write down the graylevel transformation function for the purpose.   10

4. (a) What is the circulant matrix and block circulant matrix ? Discuss the image restoration method in spatial domain.   10

   (b) Explain the least squares restoration and constrained least squares restoration and write the main features of this technique.   10

5. (a) Explain run-length coding and contour coding with a suitable example.   10

   (b) Discuss the procedure for transform image coding. What do you mean zonal and threshold coding ? Explain.   10

6. (a) Explain the gradient operators for edge detection. Discuss some common gradient operators.   10

   (b) Consider the image $I(k, j)$ and template $T(k, j)$ shown in fig. Using the performance index :   10

$$\rho(x, y) \triangleq \sum_{k=1}^{m} \sum_{j=1}^{n} |I(k + x, j + y) - T(k, j)|$$

   compute $\rho(x, y)$ for $0 \leq x \leq 2$ and $0 \leq y \leq 1$. What translation of the template produces the best match with the image :

$j \rightarrow$					$j \rightarrow$			
k	1	0	0	2	k	0	2	0
$\downarrow$	0	1	2	0	$\downarrow$	1	2	3
	2	0	2	1			$T\,(k, j)$	
	0	1	0	0				

$I\,(k, j)$

7. (a) Prove the following properties of one-dimensional Fourier transform :   10

    (i)   Linearity

    (ii)   Shift invariance

    (iii) Convolution

   (b) For the following sequence, compute first its forward and then inverse discrete Fourier transform :   10

$$[2, 3, 2, 1]$$

8. Write notes on any *three* of the following :   20

    (i)   Computer Vision System

    (ii)   Histogram features

    (iii) Image segmentation

    (iv) Differential pulse code modulation (DPCM)

    (v)   Discrete cosine transform (DCT)

    (vi) Image Processing problems and applications