Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (ECE-NEW)/SEM-8/EC-803D/2010

2010

DIGITAL IMAGE PROCESSING

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) Which one of the following transform coding systems (usually) does not decompose the input image into several sub-images before transform ?

      a) Discrete Fourier transform coding

      b) Walse-Hadamard transform coding

      c) Discrete Cosine Transform coding

      d) Wavelet Transform coding.

   ii) Huffman coding approach reduces

      a) coding redundancy only

      b) inter-pixel redundancy only

      c) coding & inter-pixel redundancy

      d) psycho-visual redundancy only.

iii) To obtain the impulse response of filter the input impulse image should be like

a) a total white image of size $M \times N$

b) a total black image of size $M \times N$

c) a white dot in a centre of black image of $M \times N$

d) a black dot in a centre of white image of $M \times N$.

iv) Which one of the following coding approaches attacks both the coding and inter-pixel redundancy ?

a) Huffman coding b) LZW coding

c) B_2 coding d) All of these.

v) The relation of intensity (I) and R, G & B in RGB colour model is

a) $I = 0{\cdot}6R + 0{\cdot}25G + 0{\cdot}15B$

b) $I = \frac{(R+G+B)}{3}$

c) $I = \frac{(R+2\ G+B)}{4}$

d) $I = 0{\cdot}5R + 0{\cdot}25G + 0{\cdot}25B$.

vi) If the image is degraded by motion blur and added noise then ..... gives the best result

a) median filter

b) inverse filter

c) Wiener filter

d) constraint least square filter.

vii) Diagonal edge can be detected by using which of the following masks ?

a)

0	1	0
1	– 4	1
0	1	0

b)

1	1	1
1	1	1
1	1	1

c)

0	1	2
– 1	0	1
– 2	– 1	0

d)

– 1	– 1	– 1
– 1	8	– 1
– 1	– 1	– 1

viii) Faulty switching introduces

a) Gaussian noise

b) Rayleigh noise

c) Gamma noise

d) Impulse noise.

ix) Poor illumination introduces

a) Gaussian noise b) Rayleigh noise

c) Exponential noise d) Impulse noise.

x) Which of the following grey level transformations produces image negative ?

a) $S = C \log (1 + r)$

b) $S = L - 1 - r$

c) $S = C r^k$

d) $S_k = \Sigma_{j=0}^{k} \frac{n_j}{n}, k = 0, 1, 2, 3, \ldots (L-1).$

xi) Erosion

a) sharps a region b) blurs a region

c) increases a region d) decreases a region.

xii) Euclidian distance of two points (x, y) and (s, t) of a two-dimensional space is

a) $\left[(x-s)^2 + (y-t)^2\right]^{\frac{1}{2}}$

b) $|x - s| + |y - t|$

c) Max ($|x - s|$, $|y - t|$)

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Prove that imaginary part of a Fourier transform of an even function is zero.

3. Show that the Fourier transform of the auto-correlation function of $f (x)$ is the power spectrum $\left|\tau(u)\right|^2$.

4. Suppose a digital image is subjected to histogram equalization. Show that a second pass of histogram will produce exactly the same result as the first pass ?

5. Discuss the limiting effect of repeatedly applying a 3 × 3 spatial filter to a digital image. Ignore the border effects.

6. Develop a procedure for computing the median of an $n \times n$ neighbourhood. Propose a technique for updating the median as the centre of neighbourhood if moved from pixel to pixel.

7. What is pixel ? Explain 4-neighbour and 8-neighbour of a pixel. Explain *m*-adjacency. 1 + 2 + 2

8. Explain image sensing and acquisition (using single sensor, sensor strip and sensor arrays).

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

9. a) What effect would, setting to zero the lower order bit planes, have on the histogram of an image, in general ?

   b) What would be observed on the histogram if higher order bit planes are set to '0' ?

   c) Obtain the Haar Transform matrix for $N = 8$. 3 + 3 + 9

10. a) Under what condition the does Butterworth low-pass filter become an ideal low-pass filter ?

b) Show that a high-pass filtered image in frequency domain can be obtained by using the method of subtracting a low-pass filtered image from the original.

c) An image is blurred by uniform acceleration in x direction. If the image is at rest at time t = 0 and accelerate with an acceleration $X_0(t) = \frac{at^2}{2}$ for a time T. Find the transfer function $H(u, v)$ to reconstruct the image. 3 + 7 + 5

11. a) Can variable length coding procedure be used to compress a histogram equalized image with two gray levels ?

b) Can such an image contain inter-pixel redundancies that could be exploited for data compression ?

c) Find a set of code words and word length using Huffman coding scheme for a set of input gray levels with probabilities as given below :

Symbol :	S1	S2	S3	S4	S5	S6	S7	S8
Probability :	0·02	0·15	0·03	0·15	0·05	0·2	0·1	0·3

d) Image blurring caused by long term exposure to atmospheric turbulence can be modelled by the transfer function $H(u,v)=\frac{\exp\left(-\left(u^2+v^2\right)\right)}{2\sigma^2}$. Assume negligible noise.

What is the equation of Wiener filter to be used to reconstruct an image blurred by this type of degradation ? 3 + 2 + 5 + 5

12. a) Construct the entire 4 bit gray code.

b) Create a general procedure for converting a gray code number to its equivalent binary and use it to decode 0111010100111.

c) The arithmetic decoding process is the reverse of the encoding process. Decode the message 0·23355 using the given coding model. Consider '!' as the terminating symbol.

Symbol :	A	E	I	O	U	!
Probability :	0·2	0·3	0·1	0·2	0·1	0·1

4 + 3 + 8

13. a) Briefly describe any three colour models.

    b) Write the conversion rules for converting RGB colour model to HSI colour model and from HSI to RGB.

    c) How a colour image can be converted into a gray scale image ? 6 + 6 + 3

14. a) Explain the chain code.

    b) What is boundary descriptor ?

    c) Explain Fourier descriptor. 8 + 2 + 5

15. a) Describe LZW coding with example.

    b) What is transform coding ? Give some examples of transform coding. 10 + 5