



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.

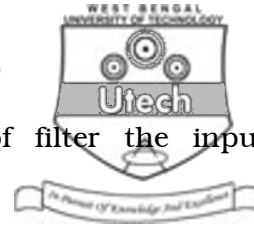
*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

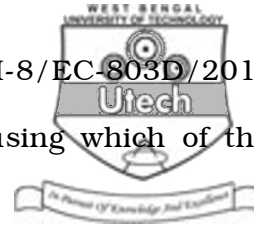
(Multiple Choice Type Questions)

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) $I = 0.6R + 0.25G + 0.15B$
 - b) $I = \frac{(R + G + B)}{3}$
 - c) $I = \frac{(R + 2G + B)}{4}$
 - d) $I = 0.5R + 0.25G + 0.25B$.
- 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) $S_k = \sum_{j=0}^k \frac{n_j}{n}, k=0, 1, 2, 3, \dots (L-1).$

xi) Erosion

a) sharpens 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) $\text{Max} (|x-s|, |y-t|)$

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

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 $|\tau(u)|^2$.



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. $3 \times 15 = 45$

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 .

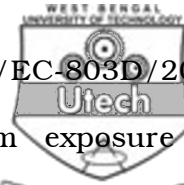
Find the transfer function $H(u, v)$ to reconstruct the image. 3 + 7 + 5

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
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