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SB-3592

M. Sc. (Part-II) (Applied Mathematics) Examination

March / April – 2011

Digital Image Processing & Discrete Time Singal Processing

Time : **3** Hours] [Total Marks : **70**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **M. Sc. (Part-II) (Applied Mathematics)**

Name of the Subject :

☛ **Digital Image Processing & Discrete Time Singal Processing**

☛ Subject Code No. : **3 5 9 2** ☛ Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

1 (a) Define the following terms : **5**

(i) Digital path

(ii) Orientation of an object in an image

(iii) Binary image

(iv) D_m distance.

(b) Write a note on application areas of image processing, and explain any two applications, in detail. **5**

(c) Explain the concept of spatial linear filtering in image enhancement. **4**

OR

1 (a) Explain the various transformations of gray level in image enhancement. **6**

(b) Define the following terms : **5**

(i) Image

(ii) Contrast of an image

(iii) Resolution of an image

(iv) Gray level of an image.

(c) Explain the differences between contrast stretching and gray level slicing. **4**

2 (a) Consider the image segment shown in the table below : 5

(p) =

0	1	2	2	3	1	$= (q)$
0	4	2	2	0	2	
1	2	1	0	1	0	
2	2	3	3	2	3	
1	0	3	0	4	4	
0	2	4	2	5	5	

By considering V={0, 1, 2}, calculate the lengths of the shortest 4- and 8- paths between the two pixels p and q. Give reasons, if any particular path does not exist.

(b) Explain the differences between histogram processing and histogram equalization. 5

(c) Explain in detail, the concept of Fast Fourier Transforms. 4

OR

2 (a) Label the image diagram given in table below; in 4- and 8- connected components. 5

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

.

(b) Define and explain by giving appropriate illustrations, the following terms for an object in an image : 5

(i) Area of an object

(ii) Perimeter of an object

(iii) Projection of an object onto horizontal and vertical lines.

(c) Distinguish between zooming and shrinking of an image. 4

3 (a) State and prove : 5

(i) The convolution property in Continuous Transform,

(ii) The correlation property in Discrete Fourier Transform.

(b) Describe briefly, the concept of Principal Component Analysis. 5

(c) Distinguish between eigen vector and eigen function. 4

OR

3 (a) Explain in detail, the process of Singular Value Decomposition. 5

(b) List out the various file formats used for images; along with their extensions and application areas. 4

(c) Define the following terms and given appropriate illustrations for each : 4

(i) memoryless system

(ii) time-invariant system.

4 (a) Define steady state response and transient response of a linear time-invariant system. State and prove that sufficient condition of stability for suddenly applied complex exponential inputs in a linear time-invariant system. 5

(b) Explain the sinusoidal response of a linear time-invariant system and using it, calculate the output of an ideal delay system. 5

(c) State the differences between : 4

(i) An Infinite duration Impulse Response (IIR) system and a Finite duration Impulse Response (FIR) system.

(ii) A conjugate - symmetric sequence and a conjugate anti-symmetric sequence.

OR

4 (a) Define a linear system. State which of the following systemes represent a stable system and justify your answer by giving reasons : 5

(i) Moving average system

(ii) Accumulator system.

(b) Define stability of a linear time-invariant system. State and prove the necessary and sufficient condition for a linear time-invariant system to be stable. **5**

(c) Prove the following : **4**

(i) Fourier transform of $x^*[-n]$ is $X^*(e^{jw})$.

(ii) $\sum_{n=-\infty}^{\infty} x[n]y^*[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{jw})Y^*(e^{jw})dw$.

5 (a) Find the sequence x[n] for which the Z-transform is : **5**

$$X(z) = z^3\left(1-\frac{1}{4}z^{-1}\right)(1-z^{-1})(1+z^{-1}).$$

(b) State the various properties of the region of convergence in the Z-transform. **5**

(c) Find the Z-transform of the sequence : **4**

$$x[n] = \left(\frac{1}{3}\right)^n u[n] + \left(-\frac{1}{4}\right)^n u[n].$$

Also represent its poles, zeros and region of convergence graphically.

OR

5 (a) Explain the process of reconstruction of a bandlimited signal from its samples. **5**

(b) Find the sequence x[n] for which the Z-transform is **5**

$$X(z) = \frac{1}{(1-z^{-1})\left(1-\frac{1}{3}z^{-1}\right)}.$$

(c) State and prove the differentiation property of X(z) for Z-transform. **4**