This Question paper consists of 2 pages. **Attempt Questions and/or Sub-Questions sufficient enough to score 100 marks**. Please print all your answers in the Answer Booklet provided. Scientific Calculator is allowed.

QUESTION 1. Write briefly about

(i) Storage Devices	**[4 marks]**
(ii) K-Means Clustering	**[6 marks]**
(iii) Information Retrieval in Library Information Science	**[4 marks]**

QUESTION 2. Give a schematic diagram of the system for summarization of multiple documents. Write the formula with clear explanation of all notations and parameters involved in K-Mixture model. Explain its use in document summarization. **[8 marks]**

QUESTION 3.

A. What is histogram and its uses in thresholding the image data? **[4 marks]**

B. Figure 1 is a four-bit greyscale image, $f(x,y)$, of size 7 x 7 pixels, depicting greyscale values of a picture in a document. These greyscale values range between 0 and 15 (4-bit image).

6	7	9	11	5	7	13
12	9	6	3	10	16	6
11	5	3	2	9	12	12
9	12	8	6	11	7	9
8	12	8	6	4	6	9
6	9	5	3	9	6	8
8	7	9	10	9	7	12

Figure 1

Convert the data shown in Figure 1 into binary form by choosing a median value as the threshold value **[6 marks]**

C.. Compute $\sum_{x,y} f(x,y)$, and plot a histogram for the above 7 X 7 multi-valued image **[6 marks]**

QUESTION 4. Compute the spatial autocorrelation via Moran's Index, by showing all the involved steps, for a spatial field shown below.

	+4	+3
+1	-6	+4
+4	-5	-2

Figure 2

Explain the interpretation of the index from the perspective of Information Science.. **[15 marks]**

QUESTION 5. What is Mahalanobis Distance? Compute it for the data, created of your choice, containing two variables (x and y) belonging to two groups (A and B). Write your conclusions about the relevance of Mahalanobis Distance in the context of information retrieval. **[12 marks]**

QUESTION 6. How to convert non-contiguous point-specific numerical data in to a contiguous zonal map? Write a full set of equations involved in Skeletonization by Influence Zone (SKIZ), and Weighted Skeletonization by Influence Zone (WSKIZ) transformations for three points (X^1, X^2, X^3) spread over discrete space, where $(X^1 \cap X^2 \cap X^3) = \phi$. **[8 marks]**

QUESTION 7. Retrieving songs from a database by query-by-humming is a study of current interest in Music Information Retrieval. Briefly explain the following: (i) Tonal similarity, (ii) time and pitch, and (iii) Hit-or-Miss Transformation. **[7 marks]**

QUESTION 8. Rectangular Granulometries is a quantitative approach for Document summarization. Firstpages of articles appearing in technical periodicals possess unique geometry of delimiter spaces. Let delimiter-space (A) and text (A^c) represent respectively foreground (in white shade) and background (in black shade). Explain how the geometry of A could be quantitatively characterized via rectangular granulometries. Give full set of equations involved in document summarization. **[8 marks]**

QUESTION 9.

A. Computation of Morphological Interpolations between the (a) sets X and Y, where $(X \cap Y) \neq \phi$, and (b) the two spatial functions f^1 and f^2, where $f^1 \wedge f^2 \neq f^1$ and $f^1 \wedge f^2 \neq f^2$. Explain on how morphological interpolations could be applied to generate the missing data. **[8 marks]**

B. Let f^i and f^j be two spatial fields. The two spatial fields of size 3×3 are shown in Figure 2a and 2b.

	(a)				(b)	
95	193	222		102	198	236
81	115	94		190	73	254
221	235	242		205	100	195

Figure 3. The two spatial fields (a) f^i, and (b) f^j

Considering the above details, address the following questions: **[12 marks]**

(i) Write an equation to compute morphological median for f^i and f^j.

(ii) Compute $\left(f^i \wedge f^j\right)$ and $\left(f^i \vee f^j\right)$

(iii) Compute $A\left(f^i\right)$, $A\left(f^j\right)$ $A\left(f^i \wedge f^j\right)$, and $A\left(f^i \vee f^j\right)$

(iv) Dilate $\left(f^i \wedge f^j\right)$ with 0B, B, and 2B (consider B as symmetric square 3×3 primitive size)

(v) Erode $\left(f^i \vee f^j\right)$ with 0B, B, and 2B (consider B as symmetric square 3×3 primitive size)

(vi) Take infima of (i) $\left(f^i \wedge f^j\right) \oplus 0B$ and $\left(f^i \vee f^j\right) \ominus 0B$, (ii) $\left(f^i \wedge f^j\right) \oplus B$ and $\left(f^i \vee f^j\right) \ominus B$, and (iii) $\left(f^i \wedge f^j\right) \oplus 2B$ and $\left(f^i \vee f^j\right) \ominus 2B$

(vii) Take suprema of three output results obtained in (f).

QUESTION 10. Let β and $(1-\beta)$ be probability values observed after first level of bisection of a map depicting spatially spread phenomenon. (ii) By considering β and $(1-\beta)$ respectively as 0.70 and 0.30, compute α_q and $f\alpha_q$ for the q values ranging between -4 to +4, and construct the $f\alpha$ spectra and find out what is information dimension. **[10 marks]**

QUESTION 11. In a database, there are a large number of images of similar size configurations and are stored in 8 bits/pixel format. Write a simple morphology-based algorithm to compute the ranks for pairing the images. Give an example of your choice to explain illustratively with support of equations. **[10 marks]**

END OF PAPER