Page No.:
Date: / /20

Q Describe image Sampling and Quantization

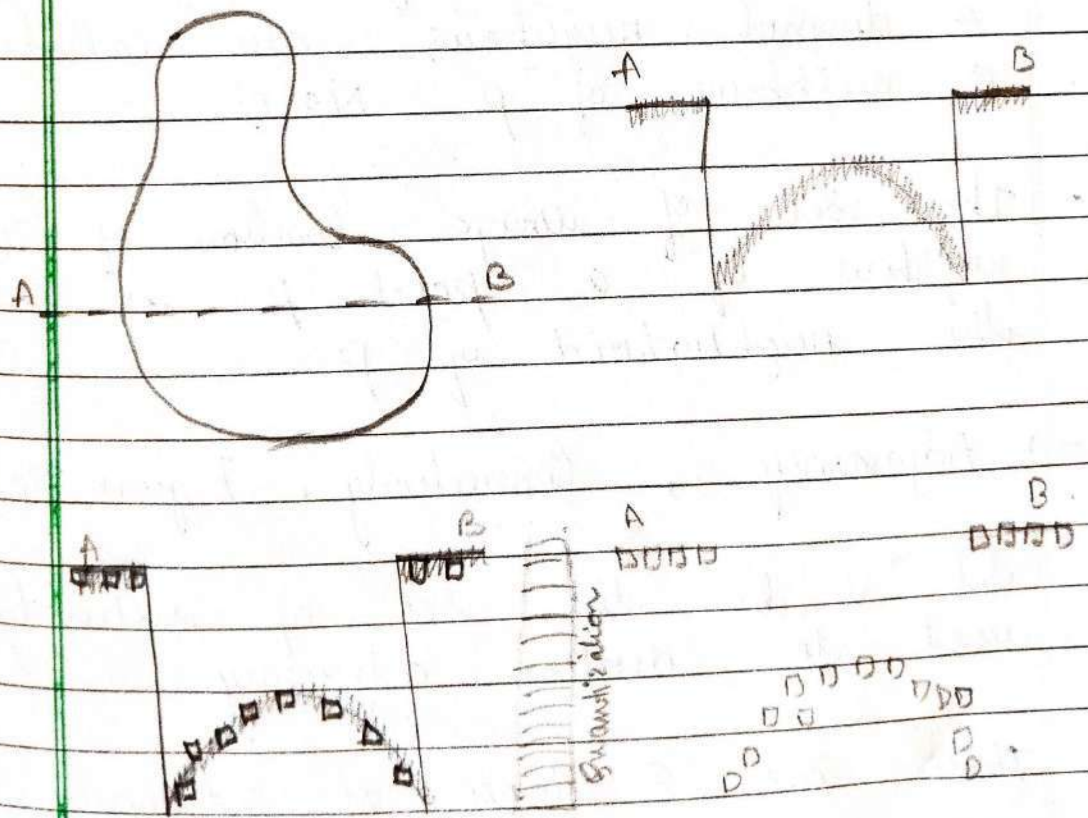
Ans:- An image may be continuous with respect to x and y coordinates & also in amplitude.

- Digitizing the coordinates value is called Sampling
- Digitizing the amplitude value is called as quantization
- The one dimensional function in fig 2.16 b is a plot of amplitude value of the Continus image along the line segment AB in fig 2.16 (a). The random variations are due to image noise to sample this function we take equal spaced Samples along line AB as in fig 2.16 (c)
- The Samples are shown in small dark squares SuperImposed on the function and their Spatial locations are indicated by corresponding tick mark in the bottom of figure
- The Set of dark Square Consitute a Sampled function.

- The values of the samples still span a continuous range of intensity values. to form digital function. The intensity value also be converted into discrete.

- The accuracy achieved in quantization is highly dependent on the noise content of the sampled signal

- The method of sampling is determined by the sensor arrangement used to generate image.



Sampling
(a) Continuous image (b) A scaned line show intensity variation along AB in continuous
(c) Sampling & Quantization (d) digital scan

Q Illustrate basic relationship between pixels.

Ans → Neighbour of a pixel :- A pixel p at Coordinates (x, y) has two horizontal & two vertical neighbour with coordinates

$$(x+1, y), (x-1, y), (x, y+1), (x, y-1)$$

(i) Set of pixel called as 4 neighbour of pixel $N_4(P)$
(ii) four diagnol neighbour $N_D(P)$

$$(x+1, y+1), (x+1, y-1), (x-1, y+1), (x-1, y-1)$$

(iii) The Combination of 4 neighbour and 4 diagnol neighbour are called as 8 neighbour of p $N_8(P)$.

- The Set of image location of the neighbour of a point p is called the neighborhood of p.

→ Adjacency, Connectivity, Region & Boundaries

Let V be the set of intensity value used to define adjacency.

There are 3 types of adjacency.

(i) 4 adjacency: two pixels p & q with values from V are 4 adjacent if q is in the set $N_4(P)$.

(ii) 8 adjacency:- two pixels P & q with values from V are 8 adjacency if q is in the set $N_8(P)$

(iii) m adjacency: It is also called as mixed adjacency. Two pixels p & q with values from V are m adjacency if (a) q is in $N_4(P)$ or
(b) q is in $N_D(P)$ and the set $N_4(P) \cap N_4(q)$ has no pixels whose value from V.

- Let S represent a subset of pixels in an image.

- Two pixels p & q are said to be Connected in S if there exists a path between them consisting entirely of pixels in S.

- The set of pixels that are Connected to it in S is called a Connected component in S. & if it has only one Component then that component is Connected to S called as Connected Set

- Let R represent a subset of pixels in an image we call R as a region of that image if R is Connected Set.

- Two Region R_i & R_j are said to be adjacent if their union forms a Connected set. & Regions that are not adjacent are said to be disjoint

Eg :-

$$\begin{array}{ccc} 0 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \qquad\qquad \begin{array}{ccc} 0 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array}$$

8 adjacency m adjacency.

$$\left.\begin{array}{ccc} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{array}\right\} R_i$$
$$\left.\begin{array}{ccc} 0 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{array}\right\} R_j$$

Two Regions

- for pixels p, q & s with coordinate (x, y), (u, v) & (w, z) respectively, D is a Distance function or matrix if

(a) $D(p,q) \geq 0$ $(D(p,q) = 0$ if $p = q)$,
(b) $D(p,q) = D(p,q)$,
(c) $D(p,s) \leq D(p,q) + D(q,s)$.

→ The Euclidian distance
$$D_e(p,q) = [(x-u)^2 + (y-v)^2]^{1/2}.$$

→ The D4 distance (city block distance)
$$D_4(p,q) = |x-u| + |y-v|$$

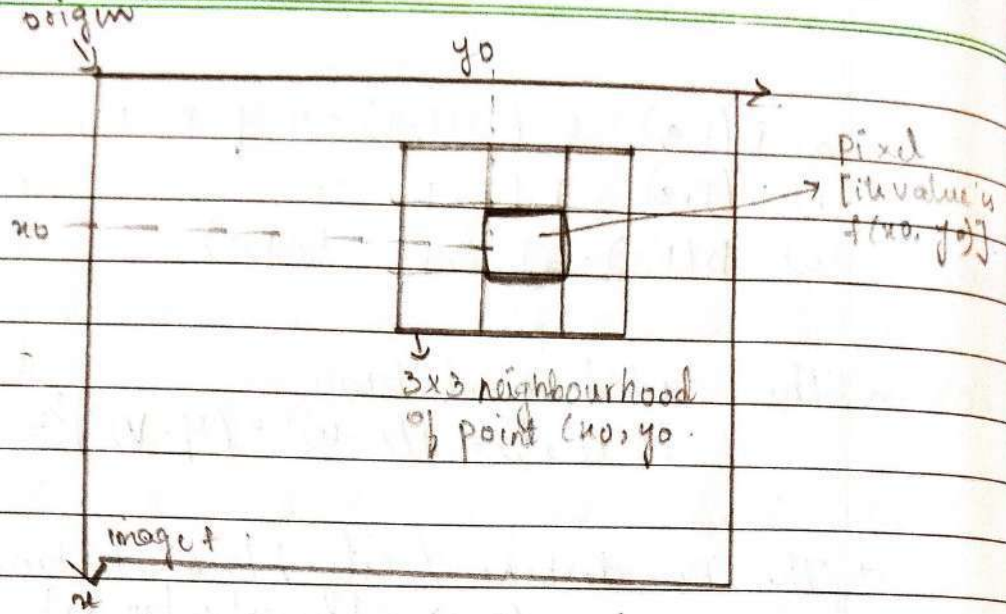
→ The D8 distance (chessboard distance)
$$D_8(p,q) = \max(|x-u|, |y-v|)$$

Q. Describe basic of intensity transformation & spatial filtering.

Ans. The spatial domain processes -

$$g(x,y) = T[f(x,y)]$$

$f(x,y)$ = input image
$g(x,y)$ = output image
T = operator on f defined over a neighbourhood of point (x,y).



The figure shows the basic implementation of the equation on single image.

- The point (x_0, y_0) shown is an arbitary location in the image and the small region shows neighbourhood of (x_0, y_0)

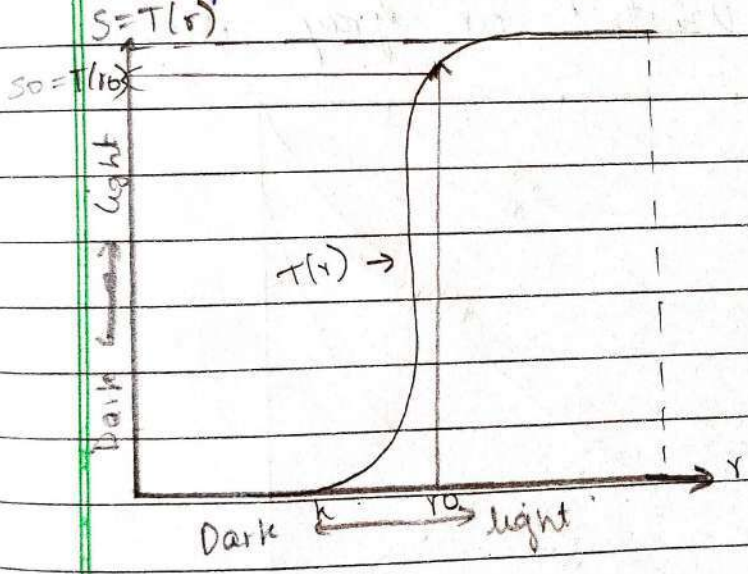
- The smallest possible neighbourhood is of size 1x1. g depends only on the value of f at a single point (x, y) & T becomes an intensity called as grey level or mapping.

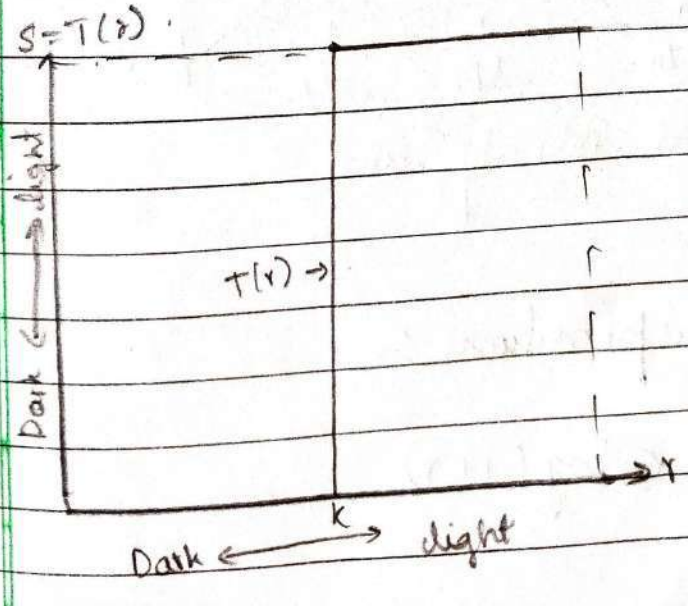
$$S = T(r)$$

- Applying the transformation to every pixel in f to generate the corresponding pixels in g would be to produce an image of higher

Contrast than the original. By darkening the intensity level below k and brightening the level above k. this is known as Contrast Streching.

- The opposite is true for values of r higher than k. • an intensity value r_0 is mapped to obtain value s_0 where $T(r)$ produces two level (binary) in image. Called as thresholding function





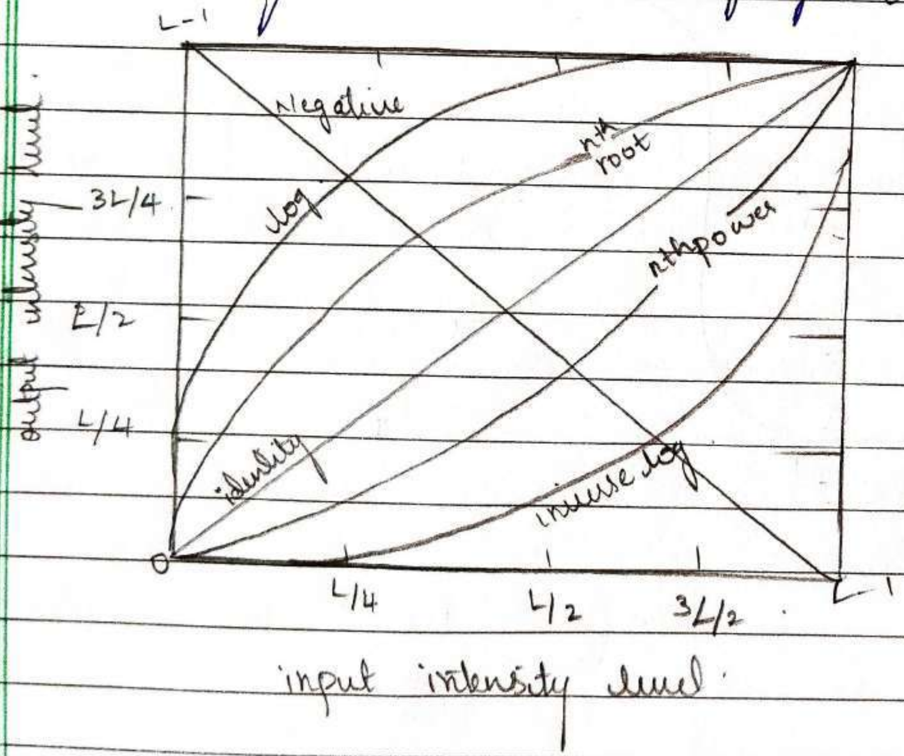
Page No.:
Date: / /20

Q Describe basic intensity transformation function

Ans:- (i) Image Negative :- The negative of an image with intensity levels in the range [0, L-1] is obtained by using negative transformation function.

$$S = L - 1 - r$$

- This type of processing is used in enhancing white or gray regions.



- (ii) log transformation :-

$$S = c \log(1 + r)$$

Page No.:
Date: / /20

c is constant & $r \geq 0$

- The shape of the log curve shows that this transformation maps a narrow range of low intensity in the input into wider range of output levels

- The opposite of this is true and is known as inverse log transformation

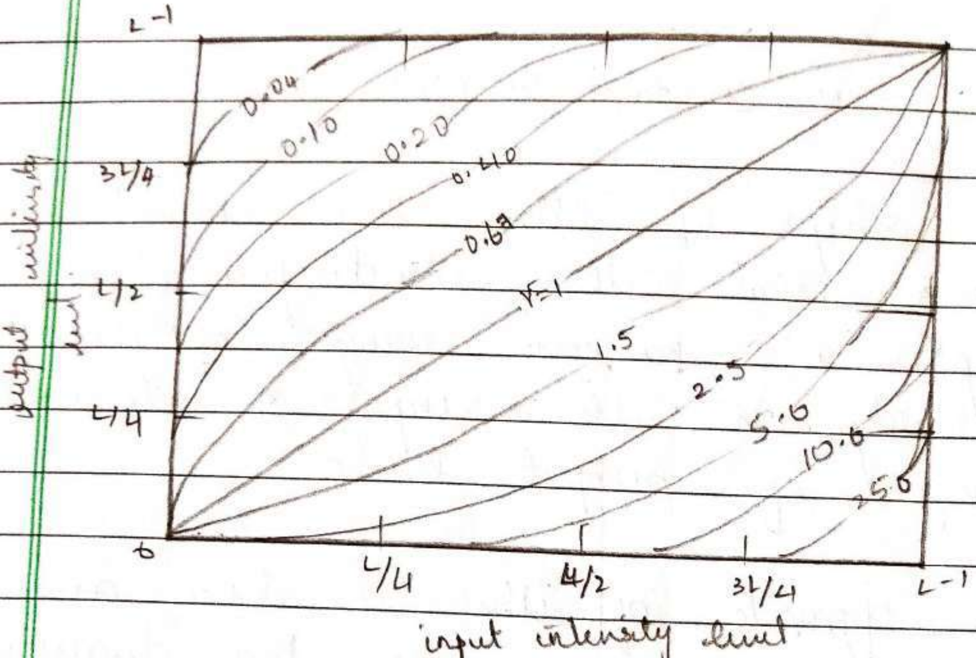
(iii) power log (Gamma) Transformations:

$$s = cr^{\gamma}$$

where c & γ are positive constants.

- As with log transformations power log curve with fraction of γ map a narrow range of dark input values into a wider range of output values.

- if $\gamma > 1$ then brighter to darker is generated & if $\gamma < 1$ then lighter to darker is generated



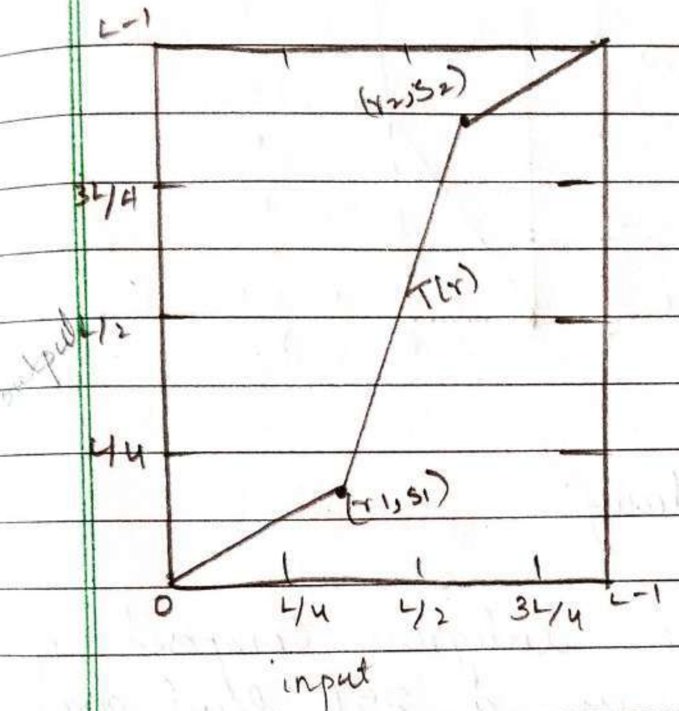
Q Describe piece wise linear transformation function.

Ans (i) Contrast Stretching :- low contrast images can result from poor illumination. lack of dynamic range in the imaging sensor during image acquisitation.

- Contrast Strecting expands the range of intensity level in image so that ~~the~~ it spans the full intensity range of the medium.

- The location of points (r_1, s_1) & (r_2, s_2) Control the shape of transformation if $r_1 = s_1$ & $r_2 = s_2$ the transformation is linear & produces no change in intensity

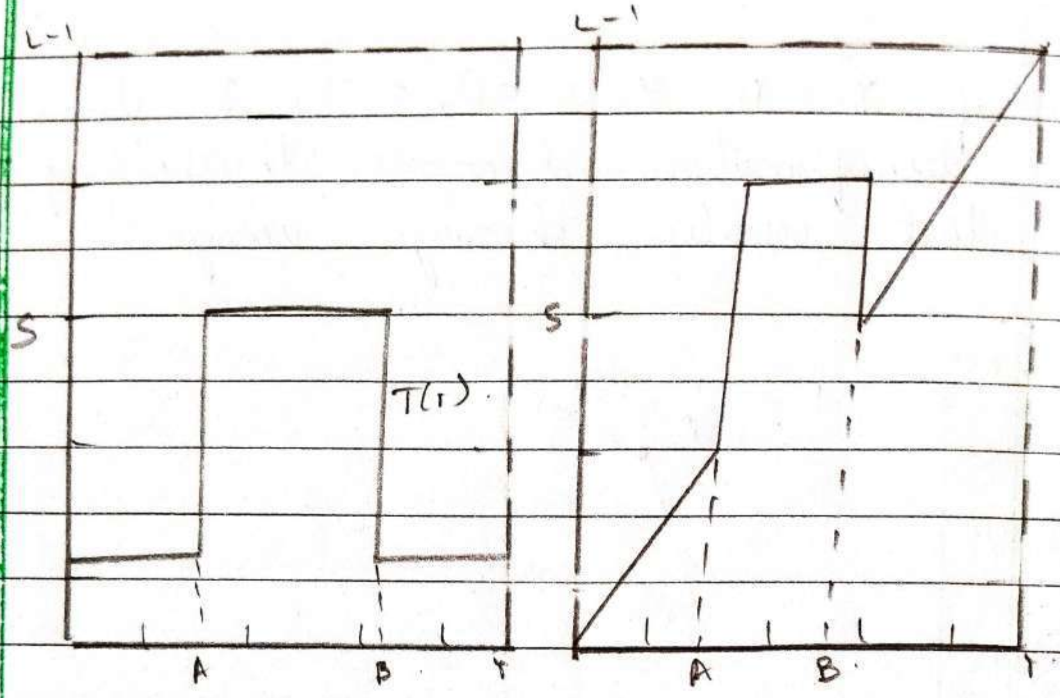
- if $r_1 = r_2$ & $s_1 = 0$, $s_2 = L-1$ the transformation becomes thresholding function that creates binary image.



(ii) Intensity level slicing : It is used to highligh a specific range of intensity in an image.

- One approach is to display in one value (white) all the values in the range & other (black) all other intensities - produces binary image

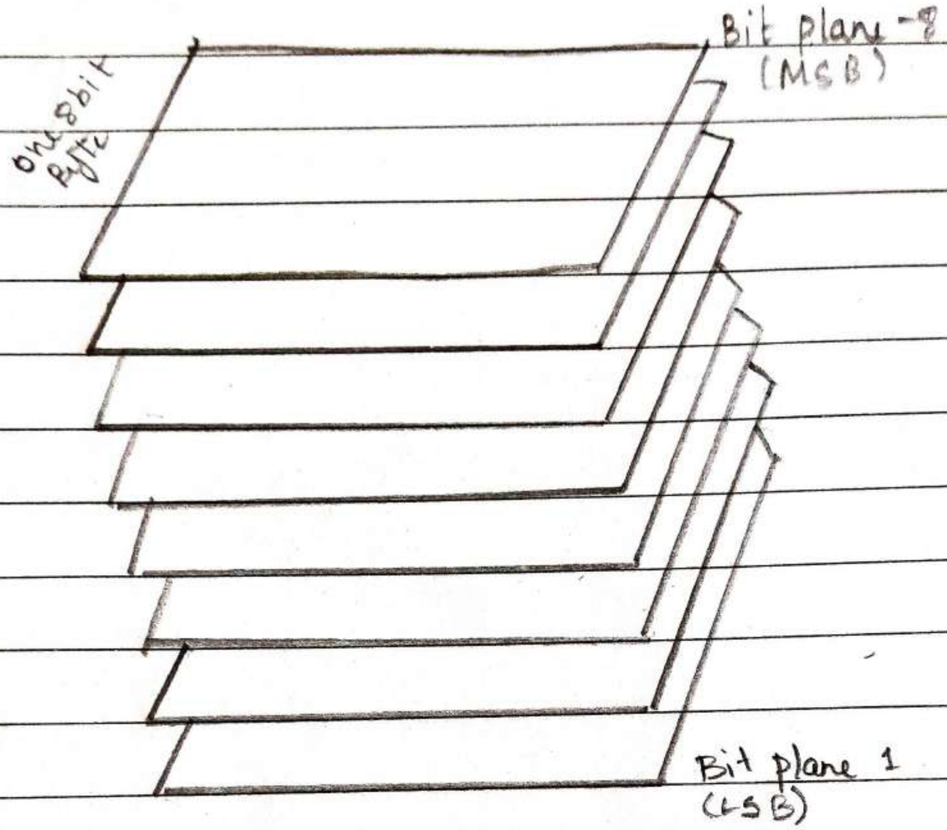
- The second approach is based on transformation brightens the disered range of intensity but leaves all other intensity level in image unchange.



(iii) bit-plane slicing:-

pixel values are integrees Composed of bits Eg:- Values in a 256 level gray Scale image are Composed of 8 bits (one byte).

- An 8-bit image may be considered as being composed of eight one bit planes. with 1 plane containing the lowest order bit of all pixel image & plane 8 all the highest order bits.


one 8bit Byte
Bit plane -8
(MSB)
Bit plane 1
(LSB)