6A ①

Zero Memory Operations.

- It is also known as point processing.
- In zero memory point operations, single pixels are used. i.e. T is 1×1 operator.
- It means that the new value $f(x,y)$ depends on the operator T and the present $f(x,y)$.
- For every input image pixel value, Transformation function gives corresponding output image pixel value, no memory location is required to store intermediate results.
- Let r denotes input image pixel value and s denotes output image pixel value
- Then $s = T(r)$, where T is any Zero memory point operation Transformation function.

Point processing techniques.

① Digital Negative Transformation
② Contrast Streching
③ Thresholding
④ Grey level slicing (. intensity slicing)
⑤ Bit Plane slicing
⑥ Dynamic range compression (Log Transformation)
⑦ Power law transformation

6 A] ⑪

Low pass filtering

- Low pass filtering (aka smoothing), is employed to remove high spatial frequency noise from a digital image. The low-pass filters usually employ moving window operator which affects one pixel of the image at a time, changing its value by some function of a local region (window) of pixels. The operator moves over the image to affect all the pixels in the image.

Median Filter

- The averaging filter removes the noise by blurring it till it is no longer seen. But, in the process, it also blurs the edges.
- If we use an averaging filter to remove the same, it will blur the noise but it would also ruin the edges. Hence, when we need to eliminate salt and pepper noise, we work with a non-linear filter known as the median filter.
- They are also called order-statistic filter because their response is based on the ordering or ranking of the pixels contained within the mask.
- In this case, we use a mask similar to the averaging filter except that the mask has no values. So it's like working directly with the 8 neighbours of the centre pixel.

- The steps to perform median filtering are as follows:

① Assume a 3 x 3 empty mask

② Place the empty mask at the left hand corner

③ Arrange the 9 pixels in ascending or descending order.

④ Choose the median from these nine values.

⑤ Place the median at the centre.

⑥ Move the mask in a similar fashion to the averaging filter.

- In median filtering, the grey level of the centre pixel is replaced by the median value of the neighbourhood. Always write the resultant in a new matrix (image).
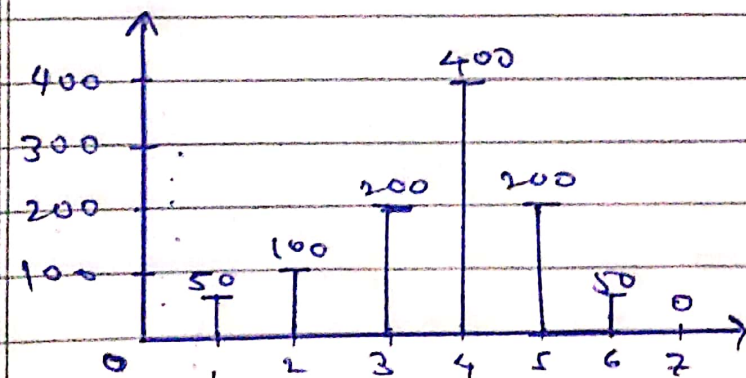
Q6 B

①

0	1	2	3	4	5	6	7
0	50	100	200	400	200	50	0

$T(m) = 1000$

	0	1	2	3	4	5	6	7
$P_K =$	0	0.05	0.1	0.2	0.4	0.2	0.05	0
$S_K :$	0	0.05	0.15	0.35	0.75	0.95	1.0	1.0
$S_K(L-1)$	0	0.35	1.05	2.45	5.25	6.65	7.0	7.0
Round off	0	0	1	2	5	7	7	7

Equalized   histogram

0	1	2	3	4	5	6	7
50	100	200	0	0	400	0	250

Original   image   Equalized   image
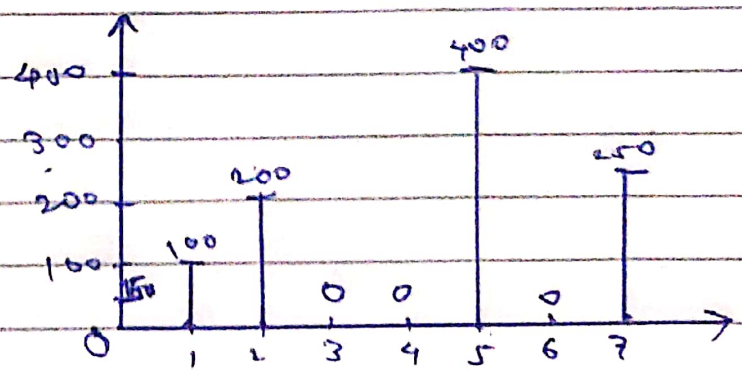
Q.6 B]

(ii)

Edge Detection

- It is the most common approach for detection of discontinuities in grey level.
- Edge detection characterizes the object boundaries
- Edge point can be thought of as pixel location of abrupt gray levels.
- It is the boundary between two regions with relatively distinct gray level properties.
- There are two types of edges. They are step and ramp edge.
- Step edges are detected using first order derivative filters like Robert, Sobel, Frichen, Prewit.
- Ramp edges are detected using second order derivative like Laplacian filter.

Techniques   of   Edge   Detection

① Prewitt   Edge   Detection.

- This method is a commonly used edge detector mostly to detect the horizontal and vertical edges in images.

- The following are the prewitt edge detection filters:

$$G_x = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix} \qquad G_y = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix}$$

Prewitt filter for vertical   Prewitt filter for
edge detection   horizontal edge detection

② Sobel   Edge   Detection

- This uses a filter that gives more emphasis to the centre of the filter. It is one of the most commonly used edge detector and helps reduce noise and provides differentiating, giving edge response simultaneously.

- The following are the filters used in this method.

$$G_x = \begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix} \qquad G_y = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

Sobel filter for   Sobel filter for
vertical edge detection   horizontal edge detection