

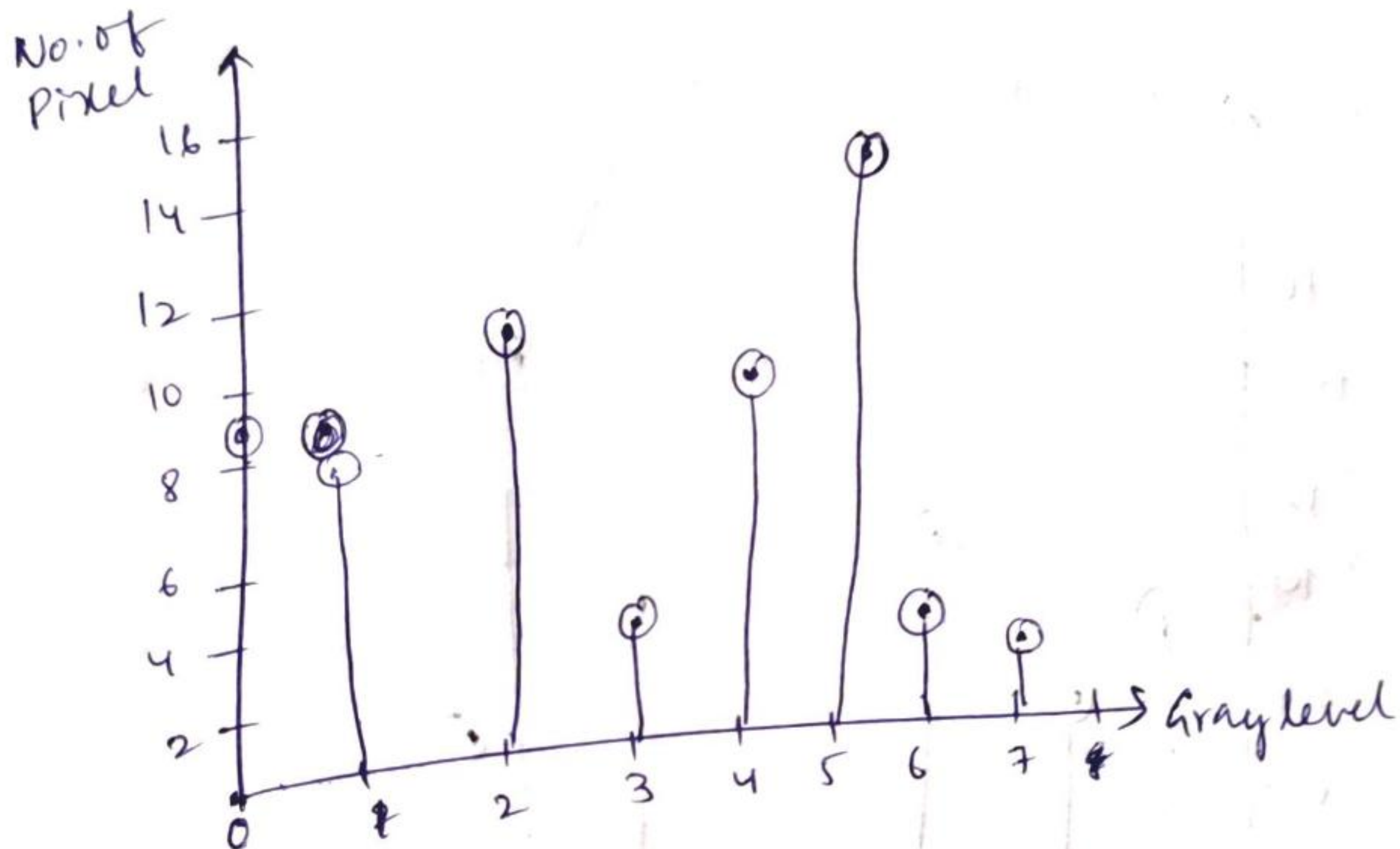
Image Processing QB

Module 2a

8

Gray level	0	1	2	3	4	5	6	7
No. of pixel	9	8	11	4	10	15	4	3

Histogram of Input Image:-



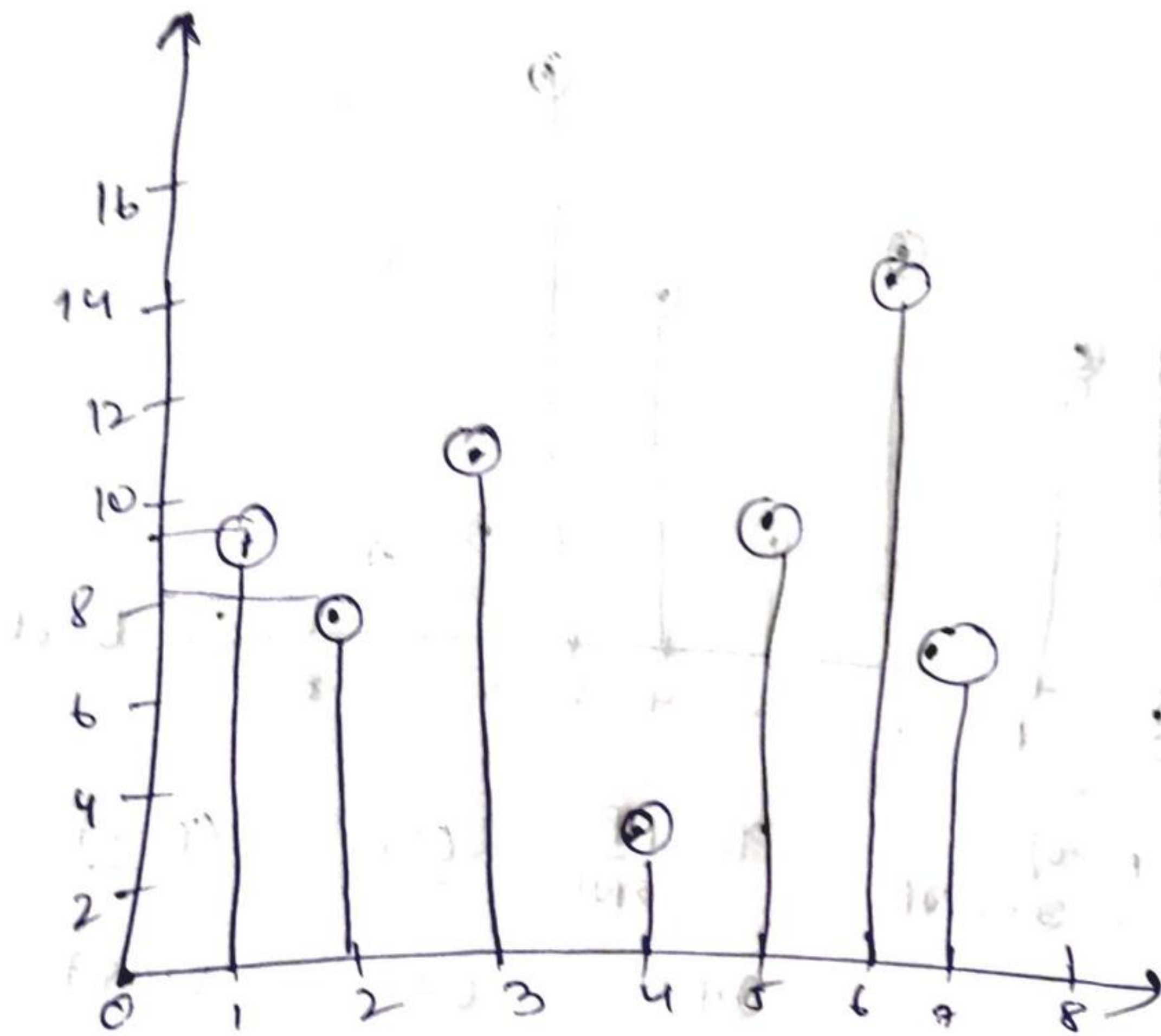
Gray levels (GL)	No. of pixels (NP)	PDF = $\frac{NP}{\sum NP}$	CDF	CDF * 7	Histogram Equ level
0	9	0.141	0.141	0.987	1
1	8	0.125	0.266	1.862	2
2	11	0.172	0.438	3.066	3
3	4	0.0625	0.5005	3.5035	4
4	10	0.156	0.6565	4.5955	5
5	15	0.234	0.8905	6.2335	6
6	4	0.0625	0.953	6.671	7
7	3	0.047	1	7	7
$\sum NP = 64$					

[multiplied by 7 as max value is 7 in range of gray levels]

Updated :

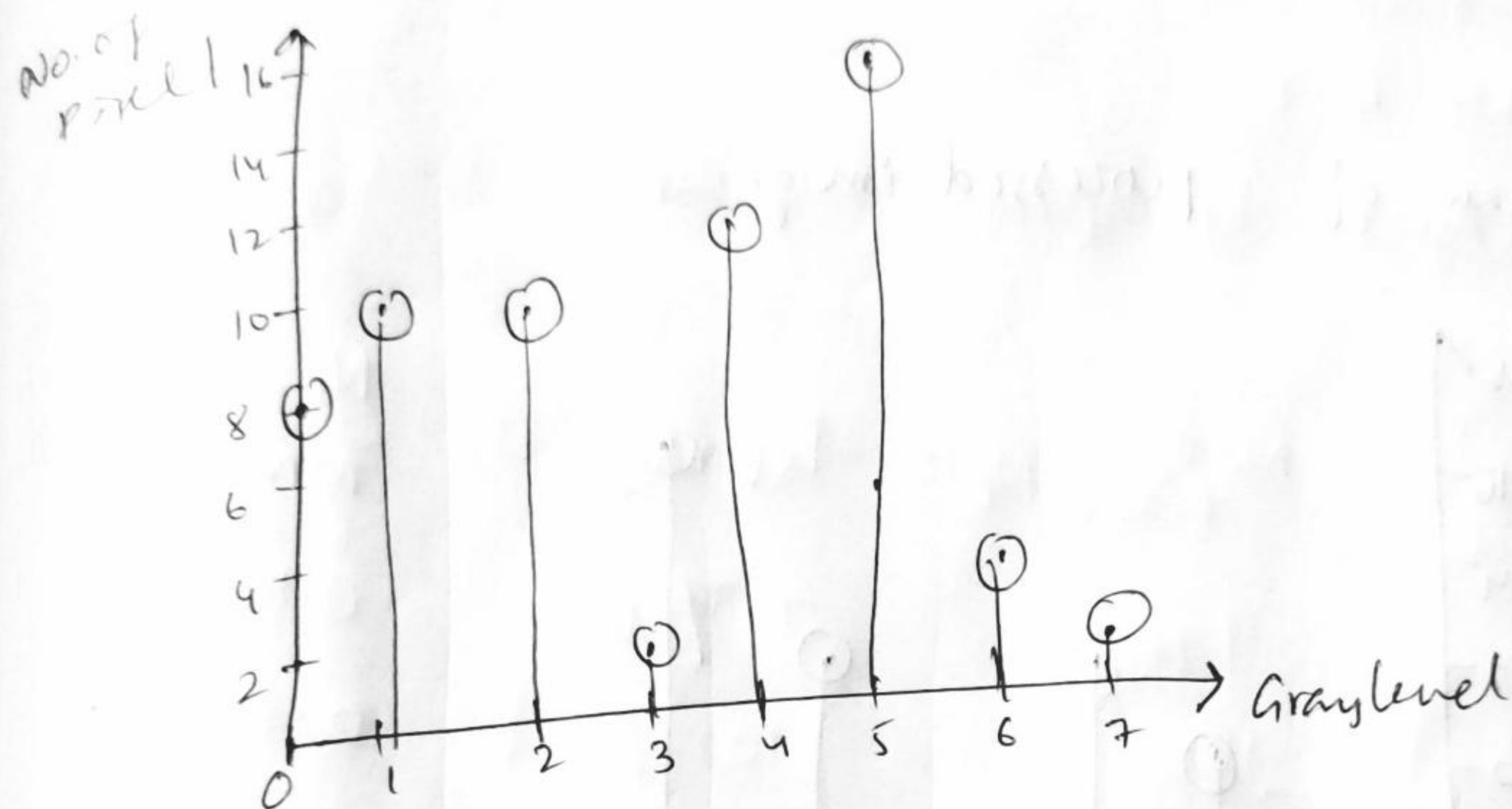
Gray level	1	2	3	4	5	6	7
No. of Pixels	9	8	11	4	10	15	4+3 = 7

Histogram of processed image



gray level	0	1	2	3	4	5	6	7
No. of pixel	8	10	10	2	12	16	4	2

Histogram of Input Image:



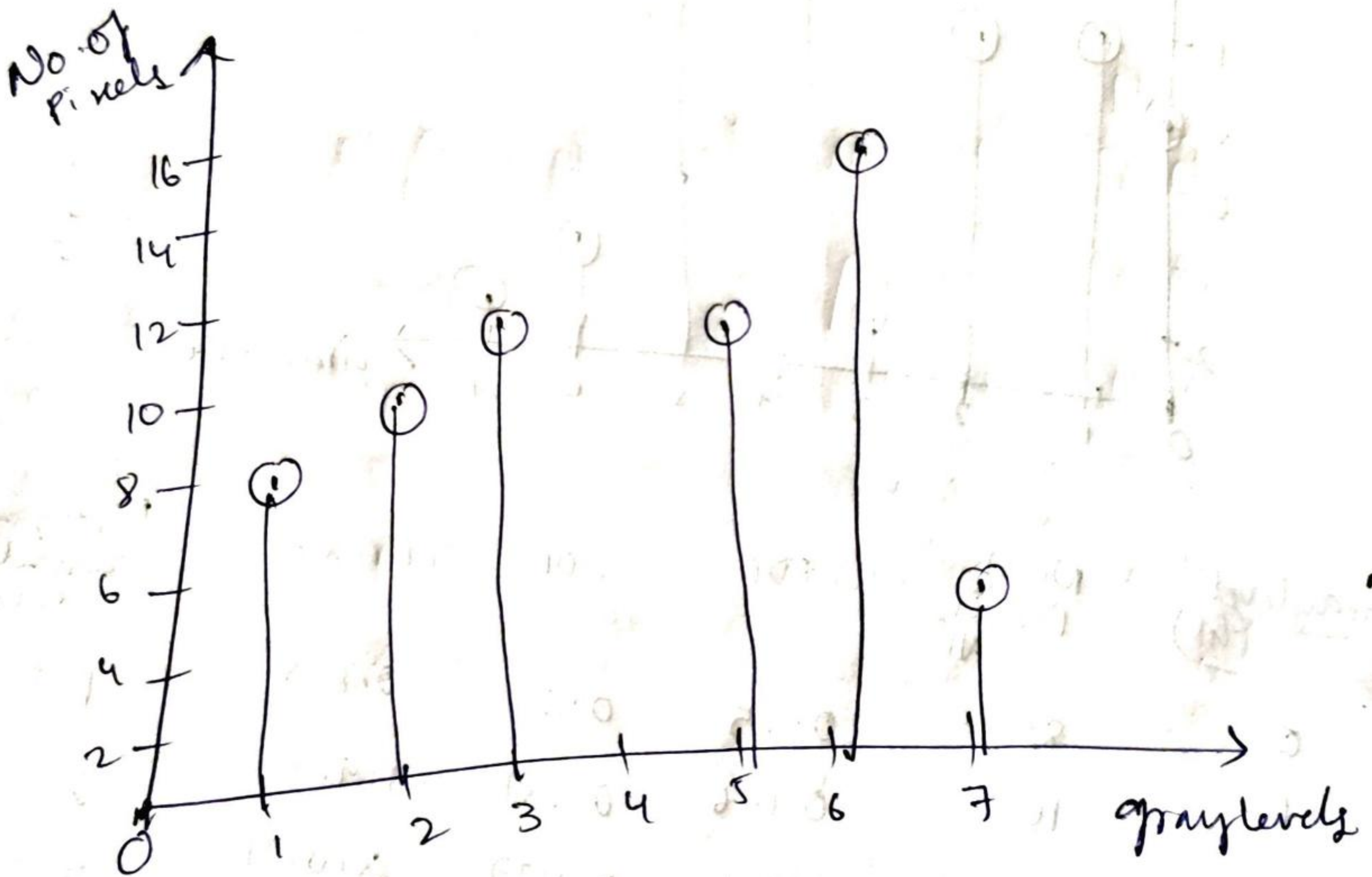
Gray level (Gk)	No. of Pixels (NP)	PDF	CDF	CDF x 7	Histogram Equal level
0	8	0.125	0.125	0.875	1
1	10	0.156	0.281	1.967	2
2	10	0.156	0.437	3.059	3
3	2	0.031	0.468	3.276	3
4	12	0.187	0.655	4.585	5
5	16	0.25	0.905	6.335	6
6	4	0.0625	0.9675	6.7725	7
7	2	0.031	0.998	6.9895	7

$$\underline{SNP = 64}$$

Updated :

gray levels	1	2	3	5	6	7
No. of pixels	8	10	$10+2$ $= \textcircled{12}$	12	16	$4+2$ $= \textcircled{6}$

histogram of processed image



② Given
$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 4 & 3 \end{bmatrix}_{3 \times 3}$$

Median filter ?

Arrange the elements in matrix in A.O

1, 2, 2, 3, 3, 3, 4, 4, 5

Median = 3

Replace median value in middle element of the above matrix

$$\Rightarrow \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 5 \\ 3 & 4 & 3 \end{bmatrix}_{3 \times 3}$$

③ Given

Gray level	0	1	2	3	4	5	6	7
No. of pixel	790	1023	850	656	329	245	122	81

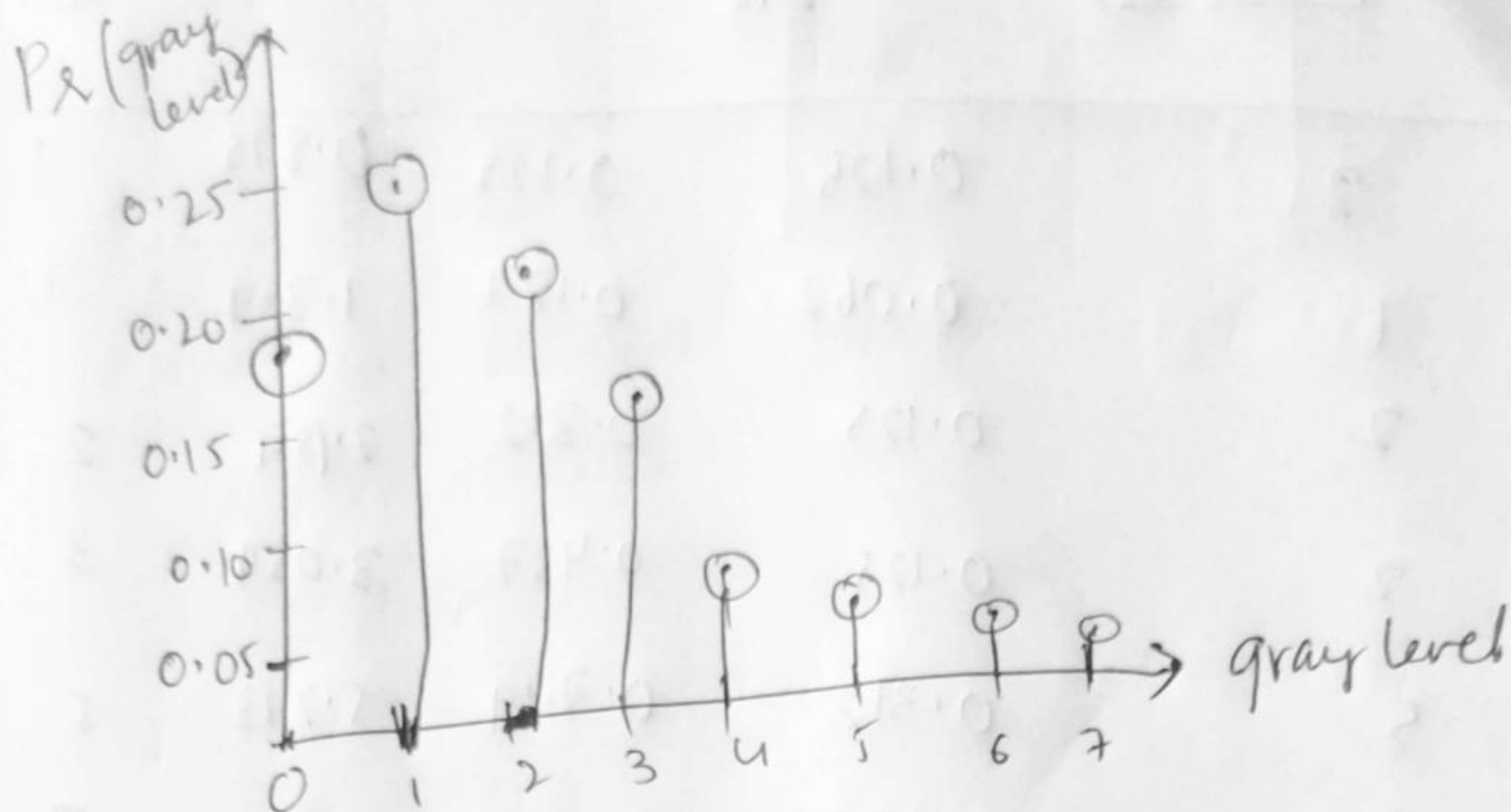
$$L=8$$

$$MN=4096$$

histogram transformation function?

Gray level	No. of pixel (N_p)	$P_r(\text{Gray level}) = \frac{N_p}{MN}$
$r_0 = 0$	790	$790/4096 = 0.19$
$r_1 = 1$	1023	$1023/4096 = 0.25$
$r_2 = 2$	850	$850/4096 = 0.21$
$r_3 = 3$	656	$656/4096 = 0.16$
$r_4 = 4$	329	$329/4096 = 0.08$
$r_5 = 5$	245	$245/4096 = 0.06$
$r_6 = 6$	122	$122/4096 = 0.03$
$r_7 = 7$	81	$81/4096 = 0.02$

Output Image :-



④ Given $\begin{bmatrix} 3 & 4 & 5 & 5 \\ 4 & 4 & 4 & 3 \\ 0 & 0 & 2 & 1 \\ 4 & 5 & 6 & 2 \end{bmatrix}$

histogram
equilization?

Soln:- Maximum pixel value = 6
represent 6 in powers of 2

Choose $L = 8$

$$\begin{aligned} 2^0 &= 1 \\ 2^1 &= 2 \\ 2^2 &= 4 \\ 2^3 &= 8 \end{aligned}$$

So range of Graylevels
will 0 to $L-1$
i.e. $[0, 7]$

Input Image:- Graylevels:- $[0, 7]$

No. of pixels :- write frequency for $[0, 7]$
from given image.

Graylevels	0	1	2	3	4	5	6	7
No. of pixels	2	1	2	2	5	3	1	0

Gray levels	No. of pixels (nk)	PDF = $\frac{nk}{\sum N}$	CDF	CDF * 7	Histogram Equalization level
0	2	0.125	0.125	0.875	1
1	1	0.062	0.187	1.309	1
2	2	0.125	0.312	2.184	2
3	2	0.125	0.437	3.059	3
4	5	0.312	0.749	5.243	5
5	3	0.187	0.936	6.552	7
6	1	0.062	0.998	6.986	7
7	0	0	0.998	6.986	7

$\sum nk = 16$

here, multiplied by 7 as max value in graylevel is 7

Updated :-

graylevels	1	2	3	5	7
No. of pixels	3	2	2	5	4

Input Image given

3	4	5	5
4	4	4	3
0	0	2	1
4	5	6	2

Output Image

3	5	7	7
5	5	5	3
1	1	2	1
5	7	7	2

3) Given

$$\begin{bmatrix} 0 & 1 & 0 & 2 \\ 2 & 3 & 3 & 2 \\ 0 & 1 & 0 & 1 \\ 1 & 3 & 2 & 0 \end{bmatrix}$$

Histogram specification?

⑧ Given

$$\begin{bmatrix} 8 & 5 & 4 \\ 0 & 6 & 2 \\ 1 & 3 & 7 \end{bmatrix}$$

Module 2b

Laplacian filter?

Soln:-

we're Laplacian operator (standard)

Positive
Laplacian
operator:-

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

Now:-

$$\begin{bmatrix} 8 & 5 & 4 \\ 0 & 6 & 2 \\ 1 & 3 & 7 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

$$= 8(0) + 5(1) + 4(0) + 0(1) + 6(-4) \\ + 2(1) + 1(0) + 3(1) + 7(0)$$

$$= 0 + 5 + 0 + 0 - 24 + 2 + 0 + 3 + 0$$

$$= 5 - 24 + 2 + 3$$

$$= 10 - 24$$

$$= -14$$

-14

Q) Given

$$\begin{bmatrix} 8 & 5 & 4 \\ 0 & 6 & 2 \\ 1 & 3 & 7 \end{bmatrix}$$

Laplacian Enhanced filter ?

Soln:

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 8 & 5 & 4 \\ 0 & 6 & 2 \\ 1 & 3 & 7 \end{bmatrix}$$

$$\begin{aligned} (0 \cdot 8) + (1 \cdot 0) + (0 \cdot 1) + (1 \cdot 0) + (-4 \cdot 6) + (1 \cdot 2) + (0 \cdot 1) + (1 \cdot 3) + (0 \cdot 7) \\ = 0 + 0 + 0 + 0 - 24 + 2 + 0 + 3 + 0 = -19 \end{aligned}$$