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18CS10062

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Image Processing (CS40019) MidSem

1.(a) (i) (c) ultra-violet
(ii) (d) Visible and infrared
(iii) (a) Gamma rays
(iv) (e) Microwaves
(v) (f) Radio waves
(vi) (d) Visible and Infrared

(b). Simultaneous Contrast

(c) Brightness Adaptation

3. No. of bits required to store 1 image = $1024 \times 1024 \times 8$

[Intensity level = $256 = 2^8$
8 bit is used to label intensity of image]

∴ No. of bits required to store 500 images

$= 500 \times (1024 \times 1024 \times 8)$
$= 4,194,304,000$ bits

Modem size → 3M-baud $= 3 \times 10^6 \frac{\text{bits}}{\text{sec}}$

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∴ Seconds taken to transmit 500 images =

$$\frac{4,194,304,000 \text{ bits}}{3 \times 10^6 \text{ bit/sec}}$$

$$= 1398 \text{ seconds}$$

4. Original Pixel → (11, 13) → (x, y)

4 nearest neighbours = (x, y−1), (x−1, y), (x, y+1), (x+1, y)

= (11, 12), (10, 13), (11, 14), (12, 13)

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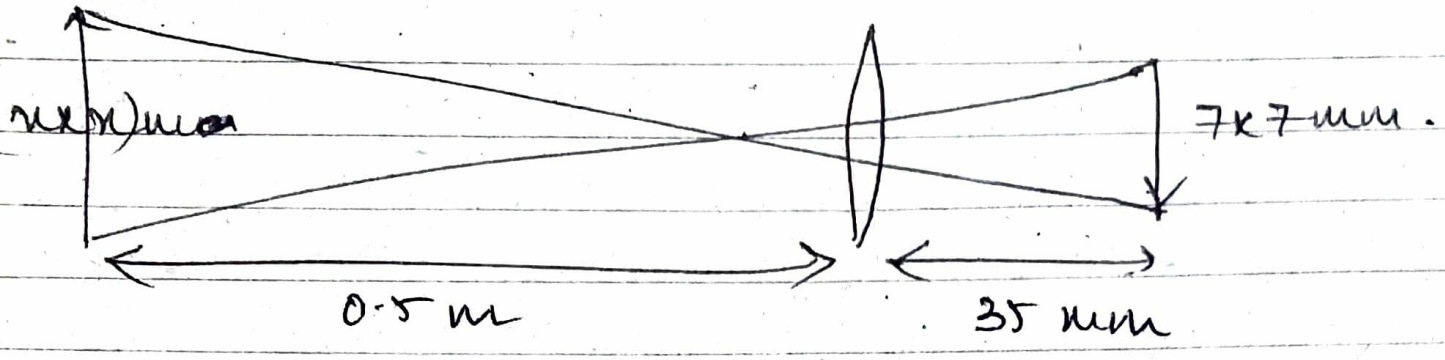
2.



$\frac{7 \text{ mm}}{35 \text{ mm}} = \frac{x \text{ m}}{0.5 \text{ m}} \Rightarrow x = 0.1 \text{ m}$ $\quad 1\text{m} = 1000\text{mm}$

$\therefore$ Size of the square $= (0.1 \times 0.1)\ \text{m}^2$

$= (100 \times 100)\ \text{mm}^2$

(100 mm on each side)

Total 1024 elements per line $\rightarrow$ Resolution of line

$= \frac{1024}{1050}$

$= 10$ elements/mm

For line pairs, we divide by 2,

$\therefore$ line pairs per mm that the camera is able to resolve

$= \frac{10 \text{ elements/mm}}{2}$

$= 5$ line pairs/mm

$V = \{0, 1, 2, 3\}$

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5. (a)

K1

1	4	13	4
2	1	3	b (2)
3	8	1	6
10	1	2	e (1)

K2

a (3)	1	5	0
c (1)	7	1	11
d (1)	2	1	2
14	3	5	9

Naming the border pixels of K_1 & K_2 in the above way (as shown in diagram)

(i) Pixel a and b are not 4-adjacent as $a \notin N_4(b)$

∴ Images K1 & K2 are not 4-adjacent

(ii) pixels a, b, c, d, e are 8-adjacent

Pairs that are 8-adjacent

(b, a), (b, c), (e, d), (b, d)

But (e, a) and (e, c) are not 8-adjacent

∴ Images K1 & K2 are not 8-adjacent

(iii) Pixels (b, a) are not m-adjacent as $b \in N_D(a)$ and $N_4(a) \cap N_4(b) = c$

Pixels (b, c) is m-adjacent as $b \in N_4(c)$

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Pixels (b,d) is not m-adjacent as $b \in N_D(d)$

and $N_4(b) \cap N_4(d) = c$

Pixels (e,d) is m-adjacent as $e \in N_D(d)$ and

$N_4(e) \cap N_4(d) = \phi$

Pixels (e,c) and (e,a) are not m-adjacent as

$e \notin N_4(c)$ and $e \notin N_4(a)$

∴ Images K_1 and K_2 are not m-adjacent

(b)

	0	1	2	3
0	(1)	4	13	4
1	2	1	3	2
2	3	8	1	6
3	10	1	2	(1)

Path from (0,0) to (3,3)

4-path (sequence) ① (0,0), (1,0), (1,1), (1,2), (2,2), (3,2), (3,3) = 6

Only 1 path exist of shortest length = 6

(1, 2, 1, 3, 1, 2, 1)

8-path

① (0,0), (1,0), (1,1), (1,2), (2,2), (3,2), (3,3) = 6

② (0,0), (1,0), (1,1), (1,2), (1,3), (2,2), (3,2), (3,3) = 7

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③ (0,0), (1,0), (1,1), (1,2), (2,2), (3,1), (3,2), (3,3)
= 7

④ (0,0), (1,0), (1,1), (1,2), (1,3), (2,2), (3,2), (3,3)
= 8

⑤ (0,0), (1,0), (2,0), (3,1), (3,2), (3,3) = 5

⑥ (0,0), (1,0), (2,0), (3,1), (2,2), (3,3) = 5

Shortest path = 5

Unity path → (0,0), (1,0), (2,0), (3,1), (3,2), (3,3)
(1, 2, 3, 1, 2, 1)

m-path

① all 4-path are m-adjacent

Shortest m-path → (1, 2, 3, 1, 2, 1) → depth = 5
as (2,0) and (3,1) are m-adjacent

6. Resultant image

$$\begin{bmatrix} 1+3 & 4+1 & 13+5 & 4+0 \\ 2+1 & 1+2 & 3+1 & 2+1 \\ 3+1 & 8+2 & 1+1 & 6+2 \\ 10+14 & 1+3 & 2+5 & 1+9 \end{bmatrix}$$

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$$\Rightarrow \begin{bmatrix} 4 & 5 & 18 & 4 \\ 3 & 8 & 4 & 13 \\ 4 & 10 & 2 & 8 \\ 24 & 4 & 7 & 10 \end{bmatrix}$$

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7. (i) We are using 4 bits, so maximum intensity value $= [1111]_2 = (15)_{10}$

∴ Complement of K1

$$\begin{bmatrix} 15-1 & 15-4 & 15-13 & 15-4 \\ 15-2 & 15-1 & 15-3 & 15-2 \\ 15-3 & 15-8 & 15-1 & 15-6 \\ 15-10 & 15-1 & 15-2 & 15-1 \end{bmatrix} = \begin{bmatrix} 14 & 11 & 2 & 11 \\ 13 & 14 & 12 & 13 \\ 12 & 7 & 14 & 9 \\ 5 & 14 & 13 & 14 \end{bmatrix}$$

(ii) Union of K1 & K2

max(1,3) max(4,1) max(13,5) max(4,0)
max(2,1) max(1,7) max(3,1) max(2,1)
max(3,1) max(6,2) max(1,1) max(6,2)
max(10,14) max(1,3) max(2,5) max(1,9)

$$= \begin{bmatrix} 3 & 4 & 13 & 4 \\ 2 & 7 & 3 & 11 \\ 3 & 8 & 1 & 6 \\ 14 & 3 & 5 & 9 \end{bmatrix}$$

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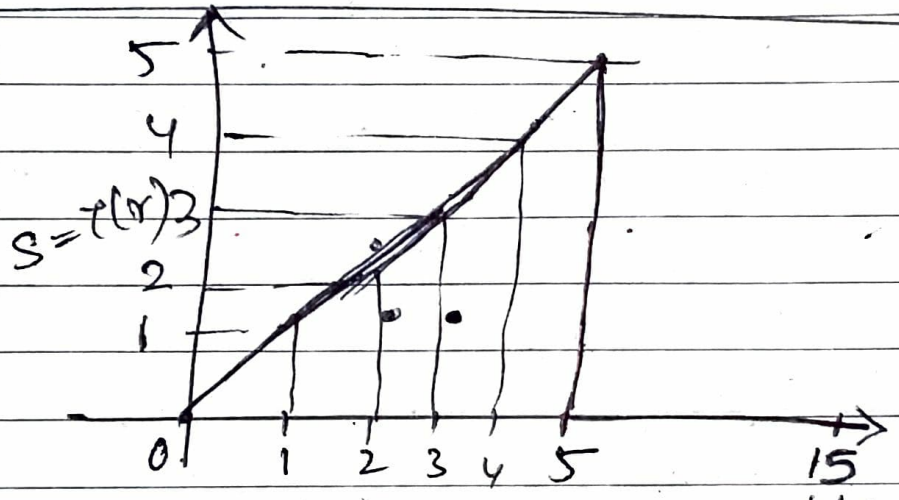
(iii) Intersection of K1 & K2

Take minimum of correspondig elements

Ans:

$$\begin{bmatrix} 1 & 1 & 5 & 0 \\ 1 & 1 & 1 & 2 \\ 1 & 2 & 1 & 2 \\ 10 & 1 & 2 & 1 \end{bmatrix}$$

9. (a)



(b)