



University of Computer and Emerging Sciences, Lahore Campus

Course Name:	DIGITAL IMAGE PROCESSING	Course Code:	CS 4055
Program:	BS (CS)	Semester:	Spring 2023
Duration:	60 Minutes	Total Marks:	35
Paper Date:	February 27	Weight	~ 15%
Section:	CS 6A, 6B & 8A	Page(s):	5
Exam Type:	Midterm/Sessional - I		

Student : Name _____

Roll No. _____

Instruction/Notes:

1. Mention Roll # & Section on each page in the given space only.
2. Complete all the questions in the given space and use space very carefully. *Spare/extra sheet is not required, complete all steps.*
3. Exam is closed books/notes.
4. Make sure that you have five different pages of the exam booklet (including this covering page)

1. (a) Define the term *Metamers* in HVS. (b) Name the phenomenon in the *neural system* that helps to create the *Mach Band effect*. (2+2 = 4)

(a) Metamers are 2 colours that ~~have~~ have a different value of spectral distribution $b(\lambda)$ and yet ^{have} the same RGB value.

(b) Lateral inhibition ~~also~~ enhances the edge values that helps create the Mach Band effect of the HVS.

9. Given the following 5x5 subimage from an image with 3 bits per pixel and average gray value of 6, find the resulting value for the center pixel by letting $k_1 = 0.8$ and $k_2 = 0.2$ and applying the following filter: ACE-1 filter: (State all steps clearly) (10)

$$\begin{bmatrix} 5 & 5 & 5 & 5 & 5 \\ 3 & 3 & 1 & 1 & 1 \\ 3 & 3 & 1 & 1 & 1 \\ 3 & 3 & 1 & 1 & 1 \\ 5 & 5 & 5 & 5 & 5 \end{bmatrix}$$

$$ACE1 = k_1 \left[\frac{m_{I(r,c)}}{\sigma_{I(r,c)}} \right] [I_{(r,c)} - m_{I(r,c)}] + k_2 m_{I(r,c)}$$

$$\sigma_{I(r,c)} = \sqrt{\frac{\sum (I_{(r,c)} - m_{I(r,c)})^2}{n^2 - 1}}$$

$$m_{I(r,c)} = 6$$

$$k_1 = 0.8$$

$$k_2 = 0.2$$

$$m_I = \frac{5+5+5+5+5+3+3+1+1+1+3+3+1+1+1+3+3+1+1+1+5+5+5+5+5}{5 \times 5} = \frac{77}{25} = 3.08$$

→ sum of (pixel value - local mean)²

$$= [(5-3.08)^2 \times 10] + [(3-3.08)^2 \times 6] + [(1-3.08)^2 \times 9]$$

$$= 36.864 + 0.0384 + 38.9376$$

$$= 75.84$$

$$\sigma_{I(r,c)} = \sqrt{\frac{75.84}{(5)^2 - 1}} = 1.778$$

$$ACE1 = (0.8) \left[\frac{6}{1.778} \right] [1 - 3.08] + (0.2)(3.08)$$

$$= -5 \rightarrow \text{converting into positive 2's complement representation}$$

pixel value will be 3

$$-5 = 101 \text{ 2's complement}$$

$$3 = 011$$

011

101

PART II

8. Given the following table of an image histogram and a specified histogram, find the mapping tables and the resulting histogram after histogram specification process is performed. (10 + 2 = 12)
(Complete all steps)

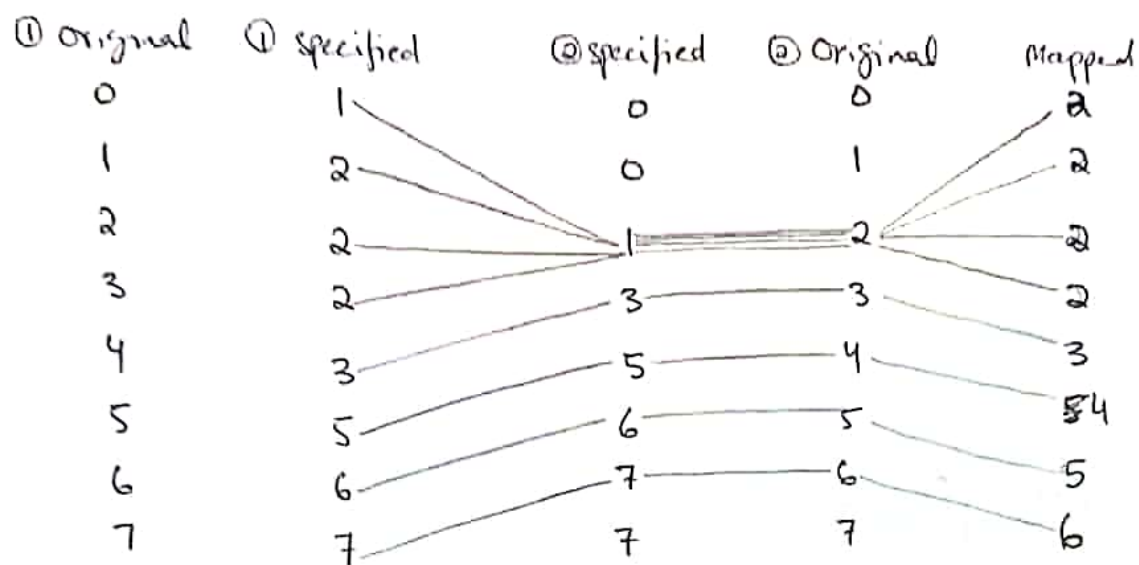
Image Histogram ①	Gray Value	0	1	2	3	4	5	6	7
	Number of Pixels	5	5	0	0	5	11	3	6
Specified Histogram ②	Gray Value	0	1	2	3	4	5	6	7
	Number of Pixels	0	0	5	10	10	5	5	0

①	0	5	—	$5/35 \times 7 = 1$	—	5
	1	5	—	$10/35 \times 7 = 2$	—	5
	2	0	—	$10/35 \times 7 = 2$	—	0
	3	0	—	$10/35 \times 7 = 2$	—	0
	4	5	—	$15/35 \times 7 = 3$	—	5
	5	11	—	$26/35 \times 7 = 5.2 \approx 5$	—	11
	6	3	—	$29/35 \times 7 = 5.8 \approx 6$	—	3
	7	6	—	$35/35 \times 7 = 7$	—	6

Gray Val	no. of pixel
1	5
2	5
3	5
5	11
6	3
7	6

②	0	0	—	$0/35 \times 7 = 0$	—	0
	1	0	—	$0/35 \times 7 = 0$	—	0
	2	5	—	$5/35 \times 7 = 1$	—	5
	3	10	—	$15/35 \times 7 = 3$	—	10
	4	10	—	$25/35 \times 7 = 5$	—	10
	5	5	—	$30/35 \times 7 = 6$	—	5
	6	5	—	$35/35 \times 7 = 7$	—	5
	7	0	—	$35/35 \times 7 = 7$	—	0

Gray Val	no. of pixel
0	0
1	5
3	10
5	10
6	5
7	5



① Original	Mapped	no. of pixels
0	2	5
1	2	5
2	2	0
3	2	0
4	3	5
5	4	11
6	5	3
7	6	6

Final

Gray val	no. of pixels
2	10
3	5
4	11
5	3
6	6

Roll. No. _____

Sect _____

10. Draw the block diagram of *Unsharp masking* enhancement.

