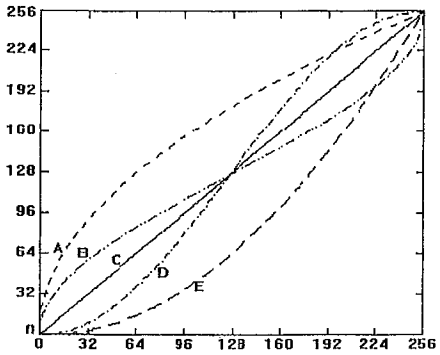
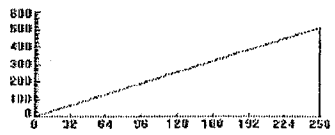
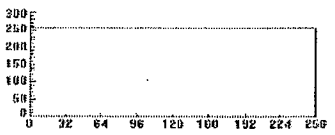
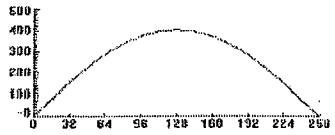
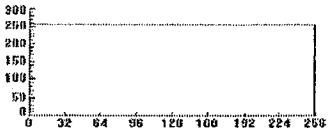
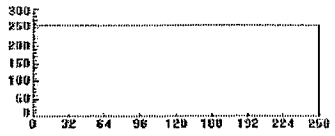
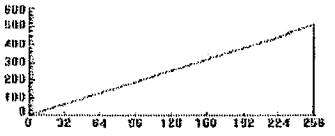
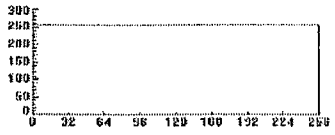
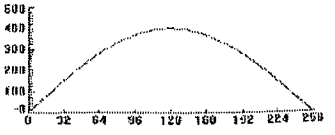
Uva Wellassa University, Sri Lanka
Computer Science and Technology
Second Semester Examination – Aug/September 2011
CST 304-3 Digital Image Processing
Time: Three (03) hours

Total five (05) questions, answer **four (04)** questions only.
Please return the question paper with answer script

Q1.

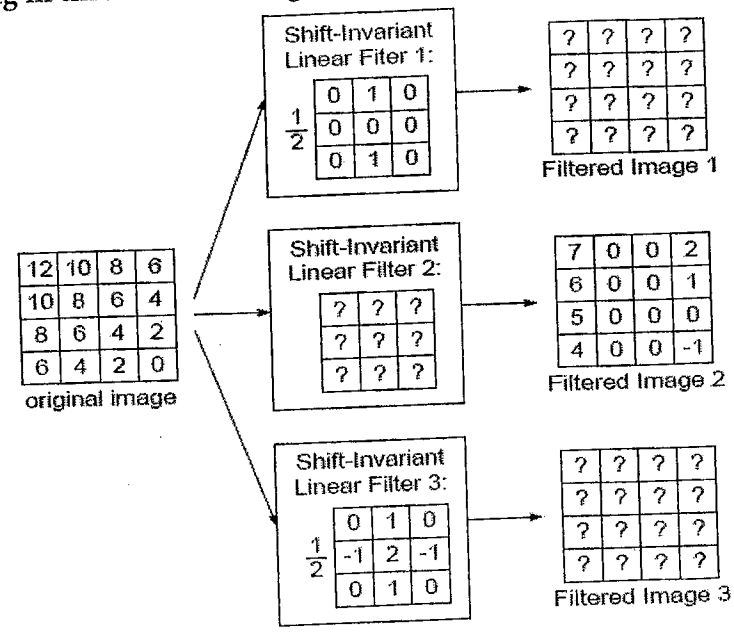
a. The diagram at the right contains several curves that could be used to transform the brightness values of a monochrome image by the operation B = T[A] where A and B are image arrays. Shown below are four pairs of histograms. Identify the transformation curve best associated with each pair and write the letter in the space in the center column. And explain the gray level transformation of each curve separately.




| Input image histogram | Transform | Output image histogram |
|---|---|---|
|  | |  |
|  | |  |
|  | |  |
|  | |  |

(16 Marks)

b. A 4×4 gray-scale original image passes through three spatial linear shift-invariant filters, resulting in three filtered images.




i. Compute "Filtered Image 1" (Use zero-padding of the original image). (3 Marks)

ii. Compute "Filtered Image 3" (Use zero-padding of the original image). (3 Marks)

iii. Based on relationships between "Filtered Image 1", "Filtered Image 2", and "Filtered Image 3", determines the filter coefficients in "Shift-Invariant Linear Filter 2." (3 Marks)

Q2.

a. Briefly describe the followings.

i. Image enhancement

ii. Image segmentation (4 Marks)

b. Describe the effects of using median filtering and local averaging for noise removal giving advantages and disadvantages of each method. (3 Marks)

c. Gray levels of an image region are shown below;

| | | | | | |
|---|---|---|---|---|---|
| 21 | 18 | 16 | 15 | 12 | 10 |
| 22 | 05A | 17 | 13 | 16 | 20 |
| 22 | 23 | 16 | 15 | 12 | 30 |
| 18 | 26 | 14 | 73B | 14 | 40 |
| 26 | 27 | 12 | 11 | 11 | 50 |
| 11 | 12 | 09 | 09 | 80 | 60 |
| 10 | 20 | 30 | 40 | 50 | 60 |

Compute the resulting gray levels for the pixels A and B (shown in bold) after performing;

i. Local averaging with a 3*3 mask (2 Marks)

ii. Median filtering with a 3*3 mask (2 Marks)

iii. Midpoint filtering with a 3*3 mask (2 Marks)

d. The line A'B' shown in the distorted image of figure Q4a below is to be corrected so that it appears as the line AB shown in figure Q4b. Derive the two functions ;

X=C1x' +C2y' and Y = C3x' +C4y' and find C1, C2, C3, C4

That can be used to correct the geometric distortion where (x, y) are the coordinates of points after correction and (x', y') are the distorted image coordinates.

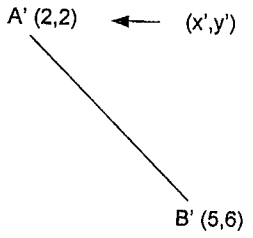



Figure Q4a

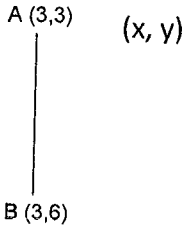



Figure Q4b

(5 Marks)

e. What is segmentation? (2 Marks)

f. Write two applications of segmentation. (2 Marks)

g. What are the three types of discontinuity in digital image? (3 Marks)

Q3.

a. Describe in detail the basic steps for image enhancement in the frequency domain.

(5 marks)

b. What is a notch filter used in image processing? Explain the effect of notch filter on the image if the notch is placed at ( 0, 0 ) frequencies. Describe an example where one may need a notch filter at (u0 ≠o and v0≠o).

(5 marks)

c. Describe three (03) types of law pass filters for image processing, and compare the performances of each of these filters. (5 marks)



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d. Write the advantages and disadvantages of frequency domain approach and spatial domain approach for image enhancement. (5 marks)

e. What is JPEG? (2 marks)

f. Explain what are the basic steps in JPEG? (3 marks)

Q4.

a. Describe what is global, local and dynamic (adaptive) threshold? (6 marks)

b. Explain the segmentation techniques that are based on finding the regions directly. (3 marks)

c. Specify the steps involved in splitting and merging? (3 marks)

d. Define what are chain codes? (3 marks)

e. Explain the steps involved in digital image processing. (3 marks)

f. Explain the properties of 2D Fourier transform. (3 marks)

g. Explain the types of gray level transformation used for image enhancement. (4 marks)

Q5.

a. What do you meant by "color model"? (3 marks)

b. Write 4 types of hardware oriented color models with the application of each model? (4 marks)

c. What is hue of saturation? (3 marks)

d. What is chromatic adoption? (3 marks)

e. Define what is image resolution? (3 marks)

f. What is meant by pixel of a digital image? (3 marks)

g. Find the number of bits required to store a 256 X 256 image with 32 gray levels? (6 marks)