MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 518: DIGITAL IMAGE PROCESSING

DATE: 22/5/2019 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question ONE and any other TWO Questions.

QUESTION ONE (30 MARKS)

a) Name and explain the three types of connectivity (6 marks)

b) Write down the formula for calculating D_4(City block distance) and D_8 distance(Chess board distance) (2 marks)

c) Consider the image below. Show the result of a 3×3 median filtering if the following masks are used. A '0' in a mask position means that the corresponding pixel is not used for calculating the median.

3	5	8	4
9	1	2	9
4	6	7	3
3	8	5	4

(a) Fig1.1

1	1	1
1	1	1
1	1	1

Fig.1.2

0	1	0
1	1	1
0	1	0

Fig.1.3

(5 marks)

d) Consider the histogram [2, 2, 4, 8, 16, 32, and 64,128] where the number of gray levels is 8.

i. Determine the output histogram of histogram equalization

ii. Using the result in (i), explain how histogram equalization enhances the contrast of an image (4 marks)

e) i Explain the need of image segmentation

ii Describe the seeded segmentation method (6 marks)

f) i Using relevant equations, describe the relationship between the average value of an image and its DFT

ii For the image in Fig. 1.4, illustrate the relationship stated in (i)

0	0	0	0
0	1	1	0
0	1	1	0
0	0	0	0

Fig.1.4 (7 marks)

QUESTION TWO (20 MARKS)

a) Consider a $M \times N$ pixel gray level image $f(x,y)$ which is zero outside $0 \leq x \leq M-1$ and $0 \leq x \leq N-1$. The image intensity is given by the following relationship

$$f(x,y) = \begin{cases} c & y = y_0 \\ 0 & otherwise \end{cases}$$

Where c is a constant value between 0 and 255 and y_0 is a constant between 0 and $N-1$.

i. Plot the image intensity

ii. Find the $M \times N$-point Discrete Transform of $f(x,y)$. Plot its magnitude spectrum.

iii. Compare the plots found in (i) and (ii) above

$$\left[\sum_{k=0}^{N-1} a^k = \frac{1-a^N}{1-a} \quad |a| \leq 1\right]$$ (10 marks)

b) i Obtain the discrete Fourier transform $H(u,v)$ of $h(x,y) = \begin{cases} 1 & x=0 \quad y=0 \\ 2 & x=0 \quad y=1 \\ 1 & x=0 \quad y=2 \end{cases}$

ii Determine the values of v for which $H(u,v) = 0$.

(10 marks)

QUESTION THREE (20 MARKS)

a) Describe the following filtering methods

i. Inverse filter

ii. Wiener filter (6 marks)

b) i Derive the transfer function $W(u, v)$ of the Wiener filter

ii Show the relationship between the Wiener filter and the

I. Inverse filter

II. Pseudo inverse filter

(14 marks)

QUESTION FOUR (20 MARKS)

a) Write down three image data compression techniques (3 marks)

b) Figure 1 shows 10×10 image with 3 different gray levels (black, grey and white)

i. Derive the probability of appearance (that forms the histogram) for each intensity (grey) level. Determine the entropy of the image.

ii. Derive the Huffman code

iii. Calculate the average length of the fixed length code and that of the derived Huffman code.

iv. Calculate the image size (in bits) between using the fixed length coding and Huffman coding. Calculate the relative coding redundancy. (17 marks)

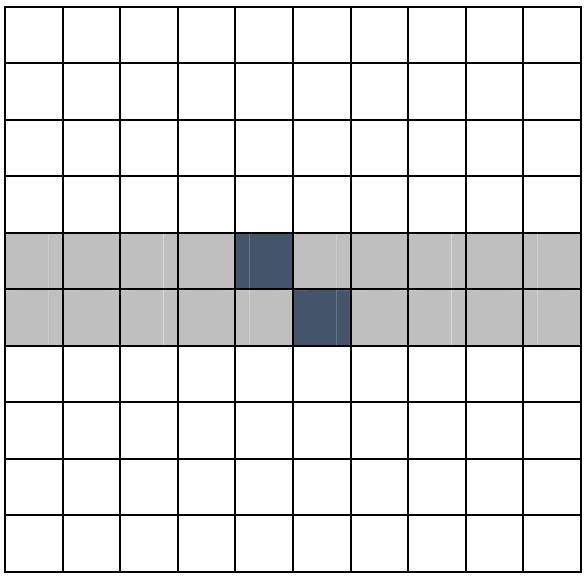

Figure 4.1

QUESTION FIVE (20 MARKS)

a) Describe the role of histogram in image processing (3 marks)

b) i Figure 5.1 shows a 3-bit 4×4 image perform histogram equalization and find the resulting image

0	0	0	4
1	1	1	5
1	2	2	7
2	2	2	7

Figure 5.1

Ii A 5×5 image is to be obtained from a 3×3 image given in Figure 5.2 . Explain the nearest neighbor and bilinear transformation and show how the resulting 5×5 will look for each of the interpolation methods.

0	2	4
2	4	6
4	6	8

Fig. 5.2 (7 marks)

c) Apply toboggan contrast enhancement to the image in Fig. 5.3. The gradient magnitude of each pixel location is given in Fig.5.4. Show all intermediate steps. (10 marks)

4	4	3	2
4	7	6	1
2	7	6	2
0	1	0	2

Figure 5.3

12	14	23	13
16	11	21	18
21	24	23	13
12	21	20	10

Figure 5.4