RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year – Semester II Examination – September / October 2020

COM 2304 – COMPUTER GRAPHICS AND IMAGE PROCESSING

Time: THREE (03) hours

- Answer **ALL** questions.
- This is a closed book examination.
- This paper includes **FOUR (04)** pages.
- Calculators are allowed

1.

a) Define an image. (04 marks)

b) Briefly explain three (03) application areas of image processing and clearly mention a real world example for each application. (06 marks)

c) Name two types of resolutions. Briefly explain each of them. (04 marks)

d) What are the key stages in digital image processing? (06 marks)

2.

a) Image Enhancement can be done in two domains. What are they? Briefly explain. (04 marks)

b) There are three types of image enhancement operations, namely; point operations, local operations and global operations. Briefly explain them with suitable examples for each. (06 marks)

c) What is Histogram Equalization? (03 marks)

d) Contrast stretching is one of image enhancement techniques. What is contrast stretching? For what purpose is contrast stretching used? (02 marks)

d) Contrast stretching can be done using following equation to each pixel of the image individually.

$$g(X,Y) = \frac{(f(X,Y) - f_{min})}{(f_{max} - f_{min})} \times (L-1)$$

Suppose that a 3-bit image (L=8) of size 4 × 4 pixels (M×N = 16) has intensities shown below. Perform contrast stretching for the given image.

35

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

(05 marks)

3.

a) What is image segmentation? (02 marks)

b) Log Transformation compresses the dynamic range of images with large variations in pixel values. It is done using S=T(r) = c * log (1+ r)
where,
S=output gray level of a pixel
c=1, and
r=input gray level of a pixel.
Get the output image of log transformation for input 8-bit gray scale image given below.

(05 marks)

100	125	235	240	150
129	122	223	235	100
123	125	212	123	239
201	205	129	125	212
126	238	223	125	150

c) Get the output image using simple average filter on input image given in part (b). Use zero padding at the edges of input image.

(05 marks)

d) What are the three (03) characteristics of chromatic light? Explain them. (04 marks)

e) Write three (03) color models used in the field of multimedia. Give a specific example of multimedia for each color model where they are used.

(04 marks)

4.

a) Noises in digital images arise during image acquisition and/or transmission. State two (02) noise types and briefly explain them.

(03 marks)

b) More interesting morphological operations can be performed using combinations of erosions and dilations (i.e. Compound operations). Name two (02) popular compound operations. Give a brief description on each.

(04 marks)

c) Apply "closing" morphological operation $f \bullet s = (f \oplus s) \ominus s$ for the image depicted in Figure 4(a) using the structuring element given in Figure 4(b). Assume that f denotes the selected image in Figure 4(a) and s denotes the structuring element shown in Figure 4(b). Further, the black pixels represent OFF pixels (0) and white pixels represent ON pixels (255). Show intermediate steps.

(09 marks)

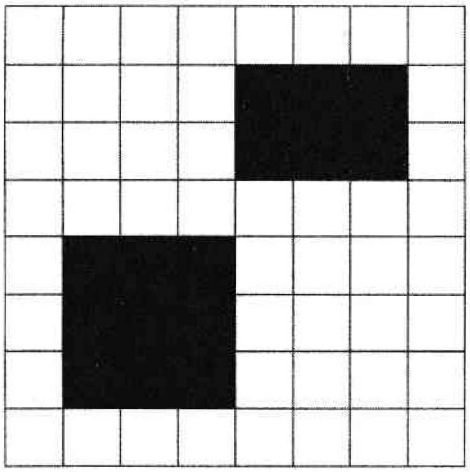


Figure 4(a): Original Image

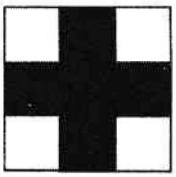
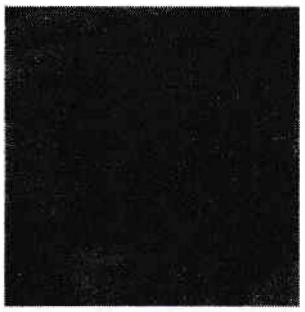
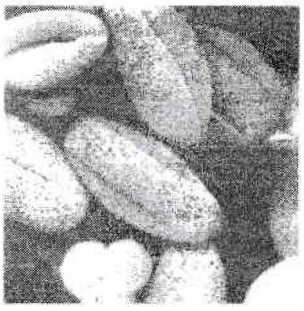


Figure 4(b): Structuring element

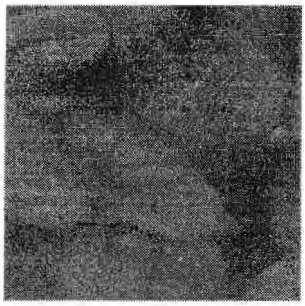
d) Draw shapes of histograms for following images (04 marks)



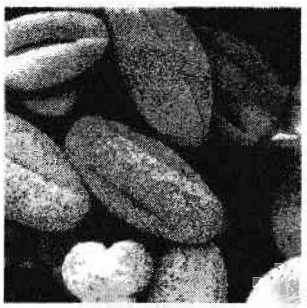
(a) A dark image



(b) A light image



(c) A low-contrast image



(d) A high contrast image

5.

a) Differentialte raster graphics from vector graphics. (04 marks)

b) Explain component of a modern graphics system. (you may use diagrams to explain further)

(04 marks)

b) The basic incremental line drawing algorithm is shown here.

```
Procedure Line (x1,y1,x2,y2 : real)
Define x,y as integer and ry,dx,dy,m as real.
dx = x2 –x1
dy = y2 – y1
    if (dx <> 0) then
        m ← dy / dx
        ry ← y1
        for x ← round (x1) to round (x2)
            y ← round (ry)
            putpixel (x,y)
            ry = ry + m
        End for
    Else
        if (dy = 0) then
            putpixel (round (x1) , round (y1))
        Else
            Report_error ("|m| > 1")
        End if
    End if
End.
```

Trace this algorithm for the line with end points (2,2) and (12,7) (06 marks)

c) The Mid-Point Circle Drawing algorithm is shown here.

```
Procedure MPCD (x0 , y0 , r : integer)
define x , y , p as integer
p = 1 – r
x = x0
y = y0 + r
while x < y
    putpixel (x , y)
    putpixel (y , x)
    putpixel (y , -x)
    putpixel (x , -y)
    putpixel (-x , -y)
    putpixel (-y , -x)
    putpixel (-y , x)
    putpixel (-x , y)
    if p >= 0
        p = p + 2(x – y) + 5
        y = y – 1
        x = x + 1
    else
        p = p + 2x + 3
        x = x + 1
    End if
End while
End
```

Trace this algorithm for the circle with radius 10 and originates at (0,0) (06 marks)

- END -