RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

BSc in Information Technology
Second Year – Semester I Examination – July/August 2023

ICT 2403 – GRAPHICS AND IMAGE PROCESSING

Time: Three (03) hours

- Answer the **ALL** questions.
- There are **Twenty (20) MCQ** questions in **part A** and **Four (04) essay** questions in **part B** printed on **Five (05)** pages.
- Write the English letter of the most suitable or correct answer for each MCQ question along with the question number.
- Calculators are allowed

PART A

1. The smallest element resulting from the discretization of the image space is called;
   A) A pixel B) A bit C) A byte D) A matrix

2. Which wave type carries more energy?
   A) Ultraviolet B) X-rays C) Gamma rays D) Microwaves

3. To map a narrow range of low gray-level input image into a wider range of output levels, we use,
   A) Negative Intensity Transformation
   B) Power-law Intensity Transformation
   C) Inverse Log Intensity Transformation
   D) Identity Intensity Transformation

4. Which technique is commonly used to reduce image noise in digital image processing?
   A) Image segmentation
   B) Image registration
   C) Image filtering
   D) Image edge detection

5. What does the term "histogram equalization" refer to in digital image processing?
   A) Adjusting image contrast
   B) Changing the image resolution
   C) Converting a color image to grayscale
   D) Rotating the image by a specific angle

6. The transformation that is used to alter the size of an object is
   A) Scaling B) Rotation C) Translation D) Reflection

7. Which method is used to extract relevant features from an image in digital image processing?
   A) Image restoration
   B) Image enhancement
   C) Image segmentation
   D) Image reconstruction

8. What is the purpose of morphological operations in digital image processing?
   A) Image smoothing
   B) Image sharpening
   C) Image scaling
   D) Image shape analysis

9. Which of the following in an image can be removed by using smoothing filter?
   A) Smooth transitions of gray levels
   B) Smooth transitions of brightness levels
   C) Sharp transitions of gray levels
   D) Sharp transitions of brightness levels

10. Which one of the following filters is nonlinear?
   A) Gaussian Filter
   B) Averaging Filter
   C) Laplacian Filter
   D) Median Filter

11. Which of the following is not a non-interactive computer graphic?
   A) Screen savers B) Brochure C) Computer game D) Cartoon

12. If the scaling factors values s_x and s_y are assigned the same value then
   A) Uniform rotation is produced
   B) Uniform scaling is produced
   C) Scaling cannot be done
   D) Rotation cannot be done

13. What does the term "bit depth" refer to in digital image processing?
   A) The number of pixels in an image
   B) The size of the image file in bytes
   C) The number of bits used to represent each pixel
   D) The color space of the image

14. Dilation can be used for
   A) Bridging gaps B) Compression C) Decompression D) Translation

15. What is the purpose of anti-aliasing in computer graphics?
   A) Enhancing image contrast
   B) Reducing image noise
   C) Adding motion blur to animations
   D) Minimizing jagged edges in images

16. Edge detection in images is commonly accomplished by performing a spatial _____ of the image field.
   A) Multiplication B) Integration C) Differentiation D) Division

17. On raster system, lines are plotted with
   A) Lines B) Dots C) Pixels D) Curves

18. An accurate and efficient raster line-drawing algorithm is
   A) DDA algorithm
   B) Mid-point algorithm
   C) Parallel line algorithm
   D) Bresenham's line algorithm

19. What is DPI with respect to printers?
   A) Dots Per Image
   B) Dots Per Inch
   C) Digital Picture Image
   D) Digital Picture Information

20. Representation types of Computer Graphics are;
   A) Scalar and Raster
   B) Vector and Raster
   C) Vector and Scalar
   D) Cluster and Raster

(20 marks)

PART B

1. a) In addition to frequency, three (03) basic quantities are used to describe the quality of a chromatic light source. What are they? Explain them briefly.

(06 marks)

b) An uncompressed color image (in RGB color model) has a pixel resolution of 1200×800. Calculate the number of megabytes required to store this image.

(04 marks)

c) List three types of spatial resolutions. State who use such spatial resolutions or on which purpose they are used.

(03 marks)

d) Suppose that a 3-bit image of size 64 × 64 pixels has the intensity distribution shown in the following table.

Input intensity values (r_k)	Frequency (n_k)
$r_0 = 0$	550
$r_1 = 1$	1062
$r_2 = 2$	906
$r_3 = 3$	586
$r_4 = 4$	432
$r_5 = 5$	224
$r_6 = 6$	152
$r_7 = 7$	184

I. Equalize the given intensity distribution using Histogram Equalization. (You may use a table to summarize the calculations)

(05 marks)

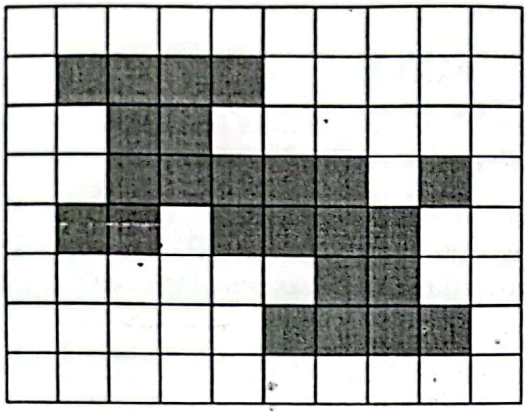
II. Show how many input pixels in each input intensity level are mapped to output intensity levels.

(02 marks)

2. a) There are three types of image enhancement operations, namely; point operations, local operations and global operations. Explain how they work using suitable examples. State image enhancement techniques categorized under each operation type.

(09 marks)

b) Apply "opening" morphological operation $f \circ s = (f \ominus s) \oplus s$ for the binary image depicted in Figure (a) using the structuring element given in Figure (b). Assume that f denotes the image in Figure (a) and s denotes the structuring element shown in Figure (b). Further, the gray pixels represent ON pixels (1) and the white pixels represent OFF pixels (0) for easiness. Show intermediate steps.



(a): Input Image

(b): Structuring Element

(05 marks)

c) Noises in digital images arise during image acquisition and/or transmission. Name two noise types and briefly explain them. Name suitable filters to remove each type of noise mentioned by you.

(06 marks)

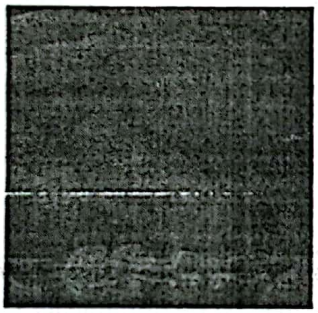
3. a) What are the three (03) basic sensor arrangements used in image sensing process? Briefly explain them. (You may use figures in your explanation)

(06 marks)

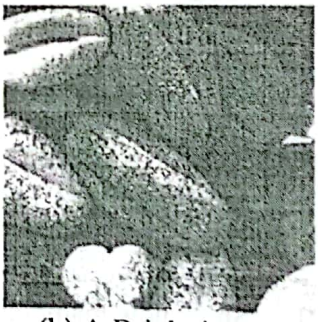
b) What is image segmentation? Explain the usage of image segmentation in image analysis and knowledge generation process.

(04 marks)

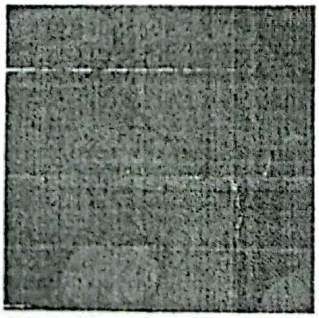
c) Draw shapes of histograms for following images.



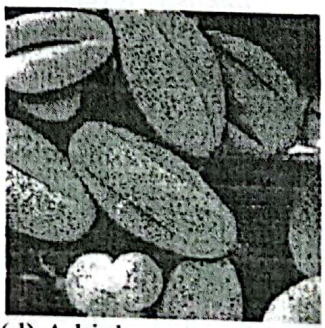
(a) A dark image



(b) A Bright image



(c) A low-contrast image



(d) A high contrast image

(04 marks)

d) Generate the output image using geometric mean filter (3 × 3) on given input image. Use zero padding at the edges of input image.

123	127	128	119	115	130
140	145	148	153	167	172
133	154	183	192	194	191
194	199	207	210	198	195

(06 marks)

4. a) What is scan conversion? How is it done? Explain using examples. (05 marks)

b) List two (02) application areas of computer graphics. Explain them briefly and clearly mention a real-world example for each application area.

(06 marks)

c) The DDA Line Algorithm is shown here.

```
Procedure LineDDA (x1, xn, y1, yn: integer)
define    dx, dy, step, i as integer
          xinc, yinc, x, y as real
dx = xn − x1
dy = yn − y1
          if abs(dx) > abs(dy) then
                    step = abs(dx)
          else
                    step = abs(dy)
x = x1
y = y1
putpixel(round(x), round(y))
xinc = dx/step
yinc = dy/step
          for i = 1 to step do
                    x = x + xinc
                    y = y + yinc
                    putpixel(round(x), round(y))
          End for
End
```

Trace this algorithm for the line with endpoints (3, 3) and (15, 9). Draw the output. (You may use a table to summarize the calculations)

(09 marks)

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