



RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences

Second Year Semester II Examination – April/ May 2016

COM 2304 – COMPUTER GRAPHICS AND IMAGE PROCESSING

Theory Paper

Time: THREE (3) hours

Examination Index No: _____

Important Instructions:

- This paper has 4 questions in 15 pages.
- Answer all questions (25 marks each).
- Write your answers in English using the space provided in this question paper.
- Do not tear off any part of this question paper.
- Note that questions appear on both sides of the paper.
- If a page is not printed, please inform the supervisor immediately.

To be completed by the examiners:

	Question numbers				Total Marks
Questions:	1	2	3	4	
Marks:					

Question 01

- i. What is the main objective of following steps in a typical image processing system?
(2 Marks)

Image Pre- processing:

Image segmentation:

- ii. Briefly describe how Sensor and Digitizer are important in acquiring digital images?
(2 Marks)

Sensor:

Digitizer:

- iii. The sensor strips are mounted in a ring configuration in some medical image modalities like Magnetic Resonance Imaging (MRI) and Computer Axial Tomography (CAT). What is the importance of having this configuration in those devices?
(2 Marks)

- iv. What happen if the quantization levels are doubled without changing the sampling levels during the digital image formation?
(1 Mark)

- v. Compute the number of bytes required to store a digitized image of 512 gray levels and 64 samples. *(3 Marks)*

- vi. Pixel replication is a technique used to increase image size. How pixel replication could be used to double the size of an image? *(2 Marks)*

- vii. Convert Red color in RGB color model to CMYK color model. Clearly show the steps and the C, M, Y and K values? *(2 Marks)*

- viii. Explain how color lookup table reduces the frame-buffer storage compared to the direct storing of colors in the frame buffer in typical graphic systems? (4 Marks)



- ix. Discuss how computer vision can be used for identity verification based on the finger print. (4 Marks)



- x. What is meant by "8 bit image"? (1 Mark)



- xi. What is "False Contouring"? (2 Marks)



Question 02

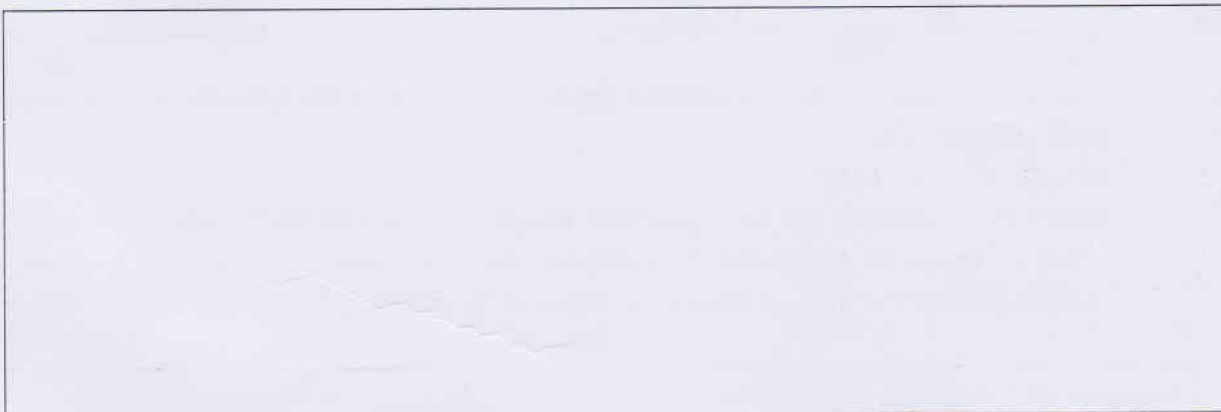
- i. A surveillance system captures the image of vehicle number plates using a digital camera. It has been observed that all of these captured images are suffered from low contrast, non-uniform illumination and impulse noise. Suggest a suitable **experimental method** for enhancing the captured images to eliminate those image degradations factors.

(4 Marks)



- ii. Justify the following statement; “Segmentation accuracy determines the eventual success or failure of computerized image analysis procedures.”

(3 Marks)



- iii. State four distinct properties of the typical region growing algorithm.

(2 Marks)

- | | |
|----|----|
| 1: | 2: |
| 3: | 4: |

- iv. Apply convolution operation to the following image using the given convolution mask and compute the convolution result only for the pixel with intensity 20. (Show all steps)
(2 Marks)

0	0	0	0	0
0	10	2	10	0
0	10	20	2	0
0	10	4	2	0
0	0	0	0	0

Image

1	2	1
2	3	2
1	2	1

Convolution Mask

- v. Following expression emphasized the application of Laplacian operation (L) for a gray scale image ($F(x,y)$).

$$G(x,y) = F(x,y) - L(F)$$

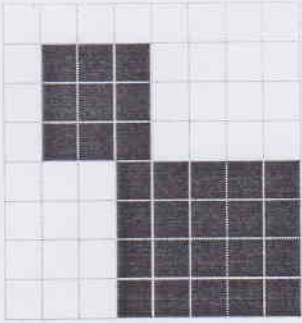

Where $F(x,y)$ denotes the input grayscale image, $L(F)$ denotes the normalized Laplacian resulting image of $F(x,y)$ and (x,y) denotes the coordinates of both input and output images. Provide the distinct features of $L(F)$ and the resulting image denotes as $G(x,y)$.

(3 Marks)

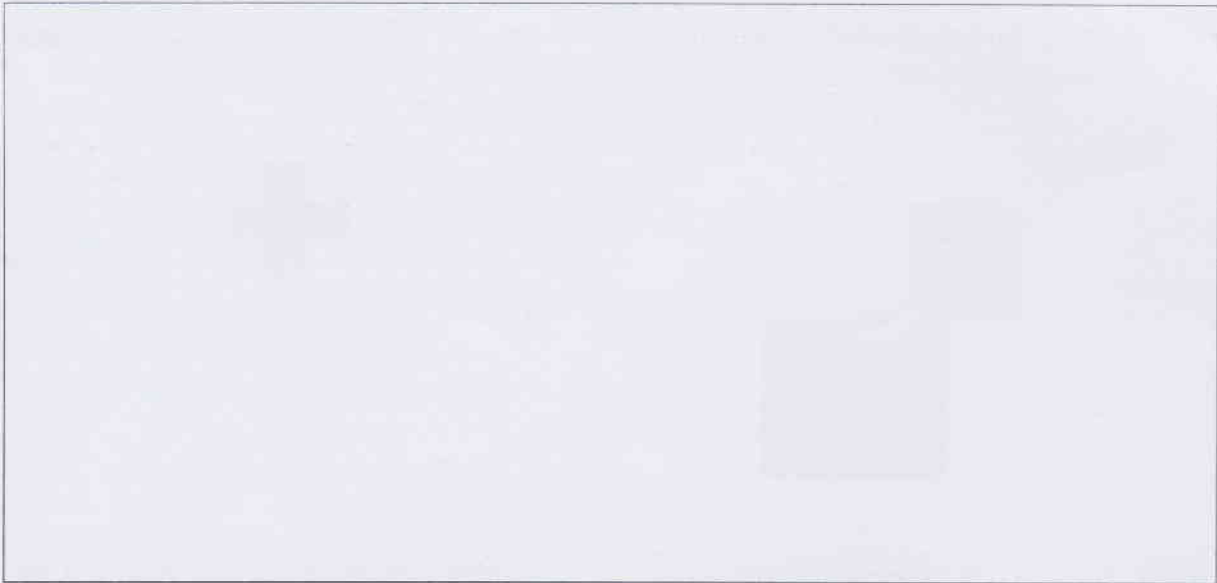
Features of $L(F)$:

Features of the resulting image denotes as $G(x,y)$:

- vi. Apply **Morphological Gradient** operation into the following image using the given structuring element. Clearly depicts the sub steps. (6 Marks)

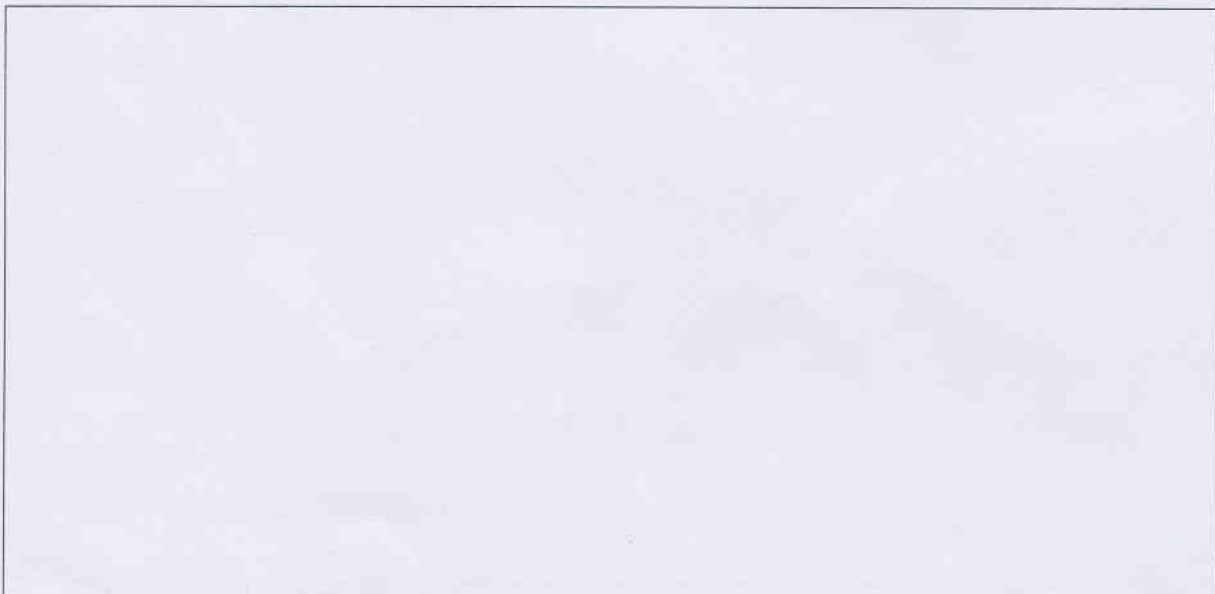
	
Image (black pixels represent foreground and white pixels represent background)	Structuring element (black cells represent on pixels – 1 and white pixels represent off pixels – 0)





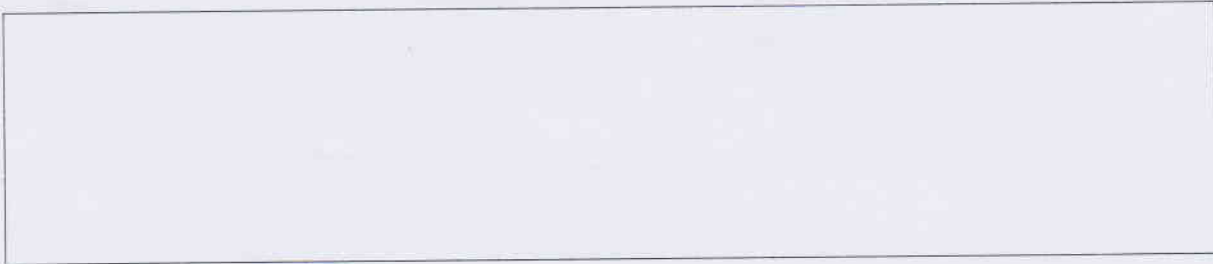
- vii. State the steps of a formal method to obtain the total number of coins in the following image. Assume the image is captured as a color image and not suffered from noise.

(5 Marks)



Question 03

- i. How many **Key Frames** are required for a 3 minutes length cartoon video which has 15 frames per second? Note that it has been produced with 12 in-between frames. (2 Marks)

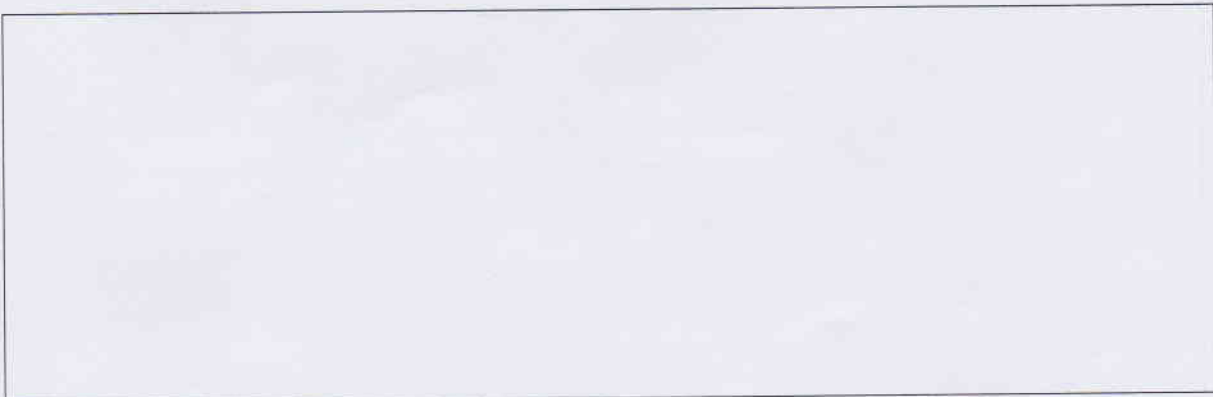


- ii. Using a diagram explain how "**arcs**" provide animation a more natural action. (3 Marks)

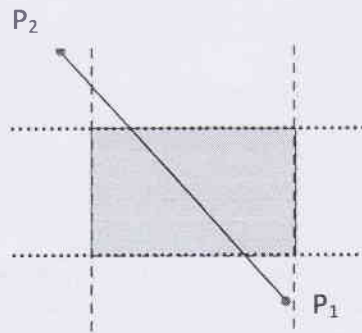


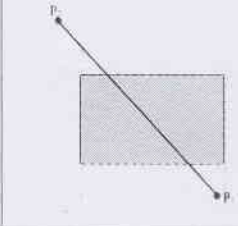
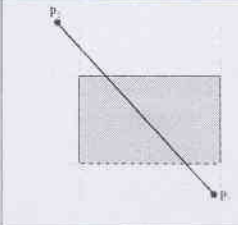
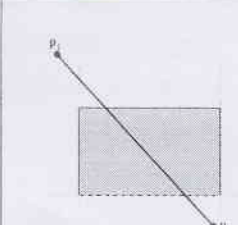
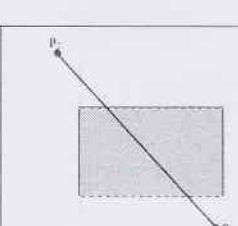
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Mihintala

- iii. What is the importance of having homogeneous co-ordinates for two dimensional geometric transformations? (2 Marks)

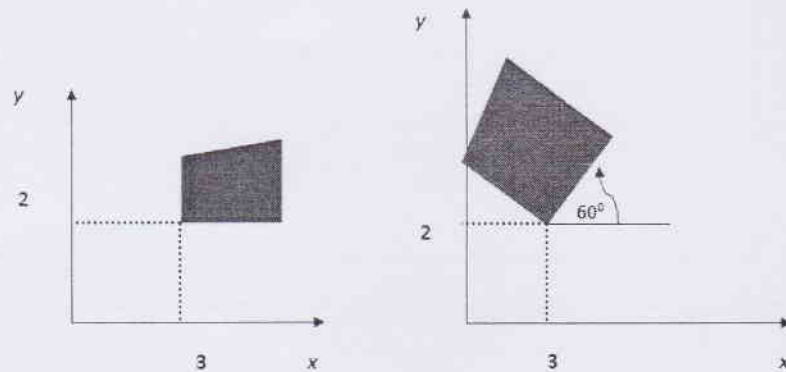


- iv. Apply Cohen-Sutherland Line Clipping algorithm for clipping the following P_1P_2 line. Clearly show the algorithm steps according to LEFT, RIGHT, BOTTOM and TOP clipping boundaries of the viewport. Sketch the clipping results according to each clipping boundary. Shaded area represents the viewport. (7 Marks)



LEFT CLIPPER	
RIGHT CLIPPER	
BOTTOM CLIPPER	
TOP CLIPPER	

- vi. State how to perform following 2D transformation using Homogeneous Co-ordinates.
"Rotate a polygon modeled at x coordinates 3 and y coordinates 2 by 60 degrees and scale it by 1.5 times."
(4 Marks)



Polygon at (2, 3) point

Expected result

Question 04

- i. State the suitable OpenCV functions used to implement following image processing operations. (3 Marks)

Separate the foreground from the background:	
Implement the flood fill operation:	
To create an IplImage structure:	
To save an IplImage structure:	
To execute morphological open operation:	
To keep a pixel point:	

- ii. Comment on following OpenCV code segments. (5 Marks)

```

IplConvKernel* kernel = cvCreateStructuringElementEx(3,3,1,1,CV_SHAPE_RECT,0);

cvCircle(src1,centre,radius,color,6,2);

int frames = (int) cvGetCaptureProperty ( capture, CV_CAP_PROP_FRAME_COUNT);

```

- iii. Write an algorithm to create a video using ten images captured by a digital camera. Assume all images have same dimension. Further, all images are color images, captured in landscape, enhanced for visual artifacts, and named consecutively starting from 1.jpg, 2.jpg, 3.jpg so forth. (5 Marks)



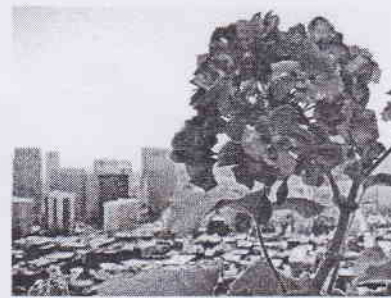
- iv. Write a C++ program using OpenCV vision library to replace the background of the following image 1 from image 2. Assume both image 1 and image 2 are grayscale images of same size. Further, note that the background intensity of the image 1 is unique and its value is 135. (12 Marks)



Image 1 – keyImage.jpg



Image 2 – background.jpg



Expected result



***** END *****