RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc. (Three Year) Degree in Information Communication Technology

Second Year Semester I Examination – October/ November 2015

ICT 2403 – GRAPHICS AND IMAGE PROCESSING

Theory Paper

Time: THREE (3) hours

Examination Index No: _____

Important Instructions:

- This paper has 4 questions in 14 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:					

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Question 01

i.   What is digital image? *(2 Marks)*

ii.   Computer vision defines as a transformation of data from a still or video camera into either a decision or a new representation. State the meaning of the two terms "decision" and "new representation" in above statement using two examples. *(4 Marks)*

Decision:

New representation:

iii. Compute the number of bytes required to store a digitized image of 128 gray levels and 32 samples.*(1 Mark)*

iv. Briefly explain how computer vision can be used for quality control in manufacturing.
(3 Marks)

v. Discuss about how Electro Magnetic Energy Spectrum is used for Medical Imaging. Note that you have to state applications under selected three different frequency bands.
(6 Marks)

vi. State why following components are required to construct a typical digital image processing system *(4 Marks)*

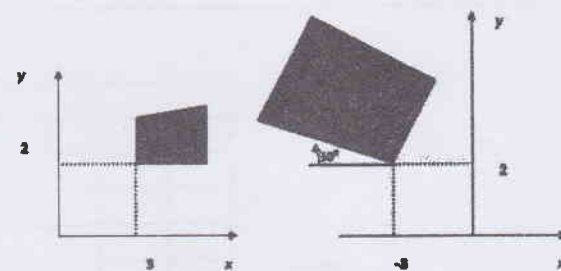**Software:**

Storage:

Hardcopy:

Network:

vii.   Sketch a diagram of an optical sensor and label main parts of it. Briefly describe the function of the sensor *(5 Marks)*

Question 02

i. Compute the CMY color values of RED color in RGB color model *(1 Mark)*

ii. Justify how to perform following 2D transformation using <u>Homogeneous Coordinates</u>. "Rotate a polygon modeled at x coordinates 3 and y coordinates 2 by 30 degrees and scale it by 2 times. Finally, get the mirror image of the transformed image along the Y axis."*(5 Marks)*

Polygon at (3, 2) point   Expected result

iii. Figure 1 depicts a matrix representation of a binary image (0 corresponds to black / foreground and 1 corresponds to white / background.).

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

Figure 1 - Binary Image

| 1	0	1
0	0	0
1	0	1

Figure 2 - Structuring element

What does the resulting image look like after applying opening operation on this binary image (Figure 1) using the given structural element in Figure 2. *(7 Marks)*

iv. State a method to extract the boundary of an object contained in a binary image using morphological operations. *(2 Marks)*

v.   Apply the boundary extraction method you stated in Question 2 part (iv) to the resulting image you obtained in the Question 2 part (iii). Clearly sketch the resulting images obtained during the intermediate steps.*(4 Marks)*
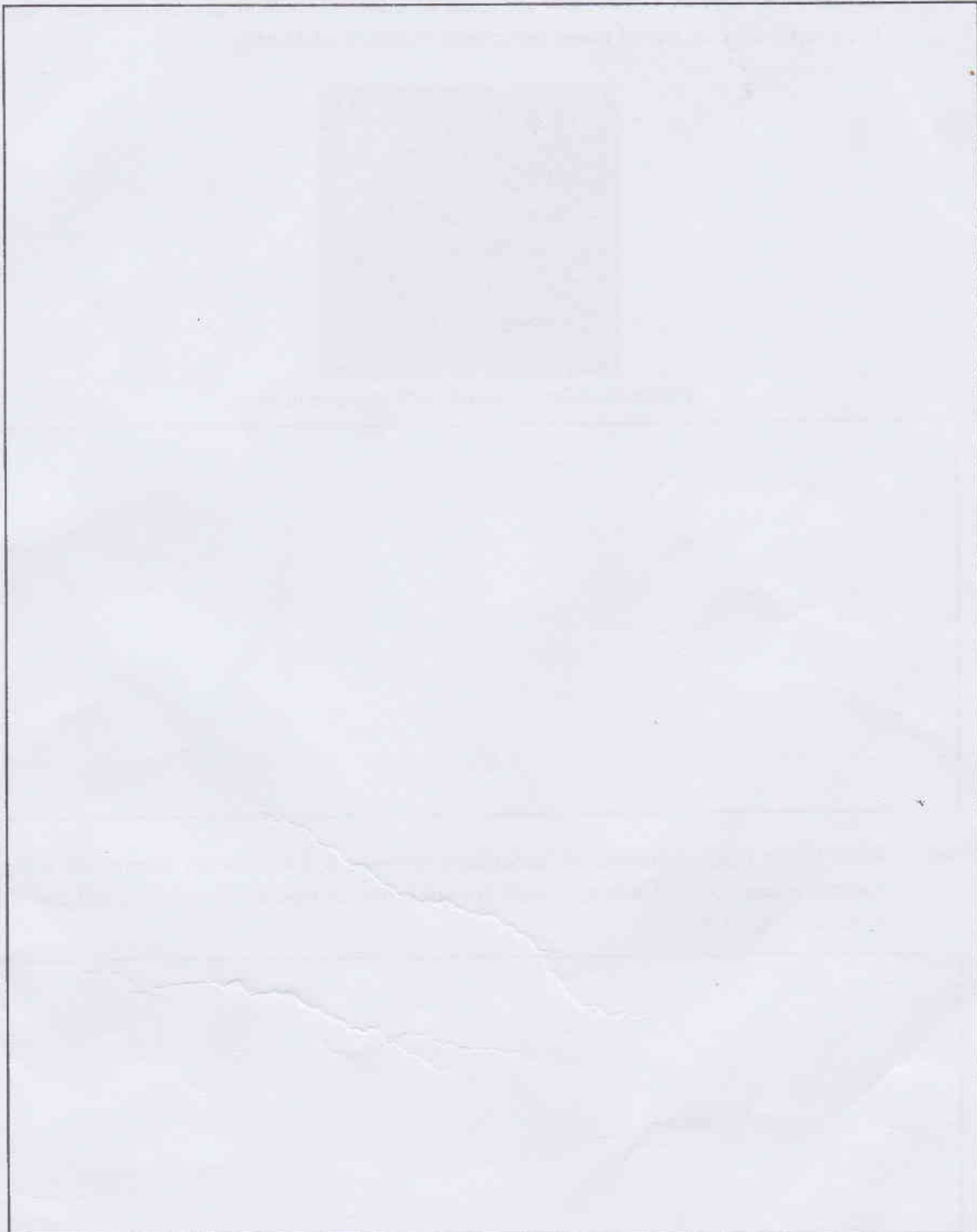
vi.   Following Figure 3 depicts a three channel image of a circuit board captured by a digital camera attached in a production line. In this image, black regions represent copper tracks and it is required to emphasize these regions for product verification. Note that this image suffers from impulse noise. State the steps of a formal method to emphasize the copper track regions of the circuit board depicted in Figure 3. *(4 Marks)*
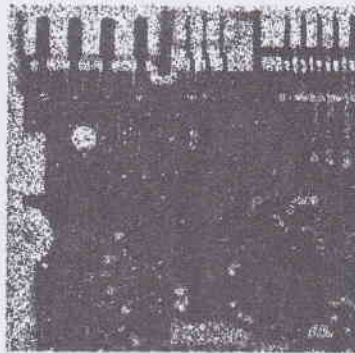

Figure 3 – Circuit Board with impulse noise

vii.   What is the main difference of histograms between a low contract image and a high contrast image? Note that both images are noise free, uniformly illuminated and contains same content. *(2 Marks)*

Question 03

i.   What is a "storyboard" used in animation production? *(2 Marks)*

ii.   Apply Sutherland-Hodgeman Polygon Clipping algorithm to clip the polygon (P, Q, R, S) shown in the clipping window (A, B, C, D) of the following Figure 4. Cleary draw the clipping result according to the clipping edge using the space given below (Clearly indicate the vertex labels.). *(6 Marks)*
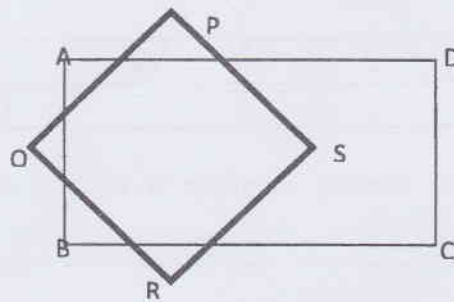
Figure 4

Input	Left clipper (AB)	Right Clipper (CD)	Bottom Clipper (BC)	Top Clipper (AD)
[P, Q]				
[Q, R]				
[R,S]				
[S,P]				
	Clipping Result 1	Clipping Result 2	Clipping Result 3	Clipping Result 4

iii. Apply <u>Bresenham's Line Drawing Algorithm</u> to draw the line from $(x_1, y1) = (20, 10)$ to $(x_2, y2) = (30, 18)$. *(6 Marks)*

Steps (k)	Decision Parameter (P_k)	X_{k+1}	Y_{k+1}

iv. Why Bresenham's line drawing algorithm is efficient than the Digital Differential Analyzer algorithm? *(1 Mark)*

v. How many <u>Key-Frames</u> required for a 120 seconds length cartoon video which has 10 frames per second. Note that it has been produced with 8 in-between frames. *(2 Marks)*

vi. It is required to transform a point 'A' in a window coordinates (3, 0.75) into a viewport coordinates which located at coordinates (4, 2) as shown in Figure 5 (ii). Figure 5 (i) depicts the focused window and its' boundary according to the world coordinates system. Find the screen coordinates of the device where that point 'A' in Figure 5(i) is transformed. *(8 Marks)*
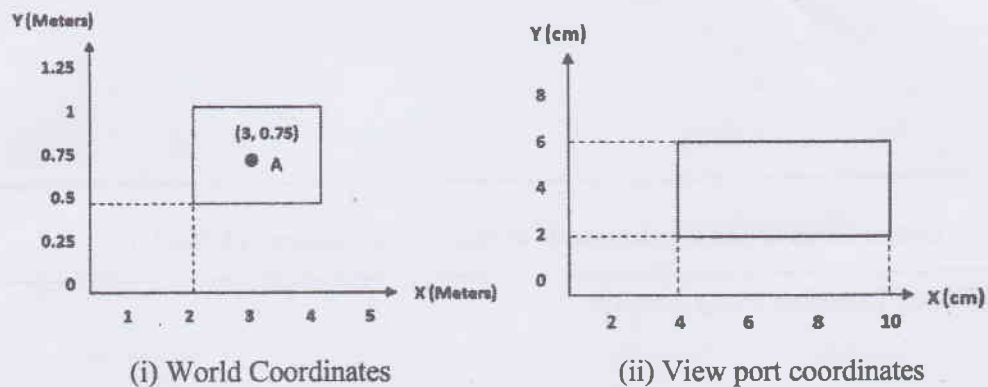

(i) World Coordinates   (ii) View port coordinates

Figure 5

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Question 04

i.   State main implementation difference between Laplacian Filter and Sobel Filter
(*2 Marks*)

ii.   Comment on following statements to explain the function. *(5 Marks)*

```
cvEqualizeHist(img,img);


cvCreateTrackbar("AMOUNT", "Gray Distribution", 10, 255, NULL);


cvSmooth(src,medianImage,CV_MEDIAN,3,3);
```

iii.   Discuss following Image Processing techniques *(4 Marks)*

Gray Level Slicing

Contrast Stretching

iv.   Write steps of a formal interactive method that can use to color the shapes as shown in the following Figure 6. *(4 Marks)*

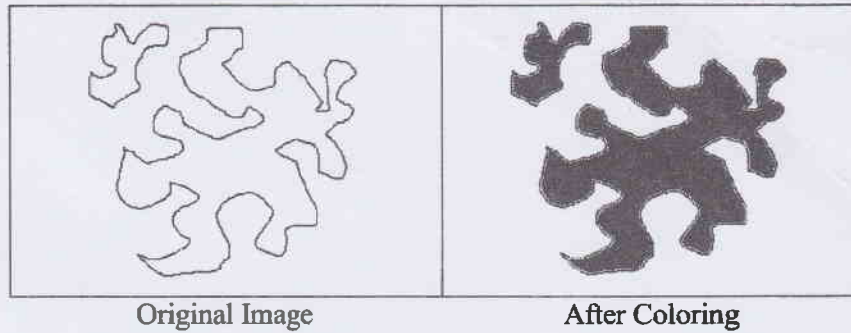Original Image   After Coloring

Figure 6

v.   Write a C++ program to extract and save the marked region in the following Figure 7 as a separate image and name it as "dog.jpg". Input image is named as "image.jpg" (Figure 7) and it is an 8 bits three channel image. Region is located at (x, y) coordinates (60, 40) and its' dimensions are 100 × 100 pixels along the width and height. *(10 Marks)*

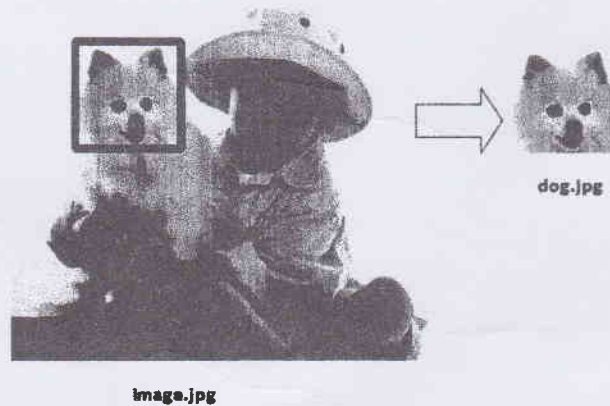dog.jpg

image.jpg

Figure 7

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