UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)
Academic Year 2010/2011 – 3rd Year Examination – Semester 5

IT5503: Computer Graphics & Image Processing

Structured Question Paper with Model Answers

11th, March, 2011
(TWO HOURS)

To be completed by the candidate

BIT Examination Index No: .....

Important Instructions:

- The duration of the paper is **2 (Two) hours**.
- The medium of instruction and questions is English.
- This paper has **4 questions** and **12 pages**.
- **Answer all 4 questions: Each question carries 25 marks.**
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book.
- Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.
  If a page is not printed, please inform the supervisor immediately.
- **Non-programmable Calculators may be used.**

Questions Answered

Indicate by a cross (×), (e.g. [X]) the numbers of the questions answered.

	Question numbers				
To be completed by the candidate by marking a cross (×).	1	2	3	4	
To be completed by the examiners:					

Index No: ……...

1) (a) Briefly explain 4 (four) application areas of computer graphics.

(4 marks)

ANSWER IN THIS BOX

(b) Explain the two terms ‘windows’ and ‘viewports’ in computer graphics applications.

(4 marks)

ANSWER IN THIS BOX

(c) A point at position (X_w, Y_w) in the window is mapped into position (X_v, Y_v) in the associated viewport. Derive the equations for the viewport position of (X_v, Y_v) using normalized coordinates.

(***Hint:*** the coordinates (Xw_{min}, Yw_{min}) and (Xw_{max},Yw_{max}) define the rectangle of the window and coordinates (Xv_{min}, Yv_{min}) and (Xv_{max},Yv_{max}) define the rectangle of the viewport.)

(6 marks)

ANSWER IN THIS BOX

(d) Draw a flow chart to show the steps involved in a typical 3D Graphics Viewing Pipeline

(5 marks)

ANSWER IN THIS BOX

(e) Name and briefly explain the three components of illumination that are used to calculate shading for an opaque surface?

(6 marks)

ANSWER IN THIS BOX

2) (a) Give the formula for a Cubic Bezier curve.

(3 marks)

ANSWER IN THIS BOX

(b) Write down the cubic Bezier curve in matrix form.

(4 marks)

ANSWER IN THIS BOX

(c) Find the parametric representation of any point (x(u), y(u)) on the Bézier curve which starts at (2,2) and ends at (4,1) and has control points (0,1) and (3, -1) respectively.

(6 marks)

ANSWER IN THIS BOX

(d) Derive the conditions necessary for two Bezier curves to join with following characteristics:

(i) C0-continuity
(ii) C1-continuity
(iii) C2-continuity

(6 marks)

ANSWER IN THIS BOX

(e) In 3D Computer Graphics, curves are represented using a parametric representation rather than a mathematical (analytical) representation. Why are parametric curves preferred over the polygonal representation?

(6 marks)

ANSWER IN THIS BOX

3) (a) Give 4 applications of Digital Image Processing.

(04 Marks)

ANSWER IN THIS BOX

(b) Explain briefly the following two noise removal techniques

(i) Neighbourhood averaging
(ii) Median filtering

(06 marks)

ANSWER IN THIS BOX

(d) Calculate the new pixel values of the shaded pixel of the following image when the above two techniques are applied separately using a 3x3 neighbourhood. Give steps of your calculations.

3	4	6	5	4
4	5	7	6	5
7	8	0	4	6
8	7	6	5	7
9	7	8	9	8

(06 marks)

ANSWER IN THIS BOX

(e) Segmentation of an image into useful regions is an important operation in image analysis. Name two image segmentation techniques.

(04 marks)

ANSWER IN THIS BOX

(f) An image needs to be enhanced as the objects in the image are not visible. What is the technique you would suggest?

(05 marks)

ANSWER IN THIS BOX

4 (a) What operation is achieved by convoluting an image with the following mask?

1	0	-1
2	0	-2
1	0	-1

(04 marks)

ANSWER IN THIS BOX

(b) Give another 3x3 mask which can be used to detect edges in an image together with the mask given in (a).

(04 marks)

ANSWER IN THIS BOX

(c) Give steps of detection of edges using the Laplacian operator.

(06 marks)

ANSWER IN THIS BOX

(d) If n_1 and n_2 denote the number of information carrying units in two data sets that represent the same information, write the formula for *relative data redundancy* R_D of the first data set (the one characterized by n_1).

(05 marks)

ANSWER IN THIS BOX

(e) Outline the difference between Lossy and Lossless data compressions.

(04 marks)

ANSWER IN THIS BOX

(f) Name one Lossless image compression technique and one Lossy image compression technique.

(02 marks)

ANSWER IN THIS BOX

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