THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma

COMPUTER GRAPHICS

9th May 2003, 2.30 p.m.-5.30 p.m.
Answer THREE questions out of FIVE. All questions carry equal marks.
Time: THREE hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. *a)* Describe the three key characteristics which can be determined from a light energy spectrum.

(6 marks)

b) What is a colour gamut? What limitation do all colour gamuts suffer from in practice? **(4 marks)**

c) A colour is defined as (0.9, 0.4, 0.4) in the RGB model. What are its components in the CMYK model?

(4 marks)

d) *i)* Briefly describe the three main components in Phong's illumination model. **(6 marks)**

ii) What additional light sources can be added to Phong's model to improve visual realism and how can they be taken into account? **(5 marks)**

2. *a)* A PC equipped with a TV tuner receives a colour signal which, once demodulated, results in a colour difference signal. The colour difference model can be converted to the RGB model needed for the monitor's CRT by a mapping matrix, <u>M</u>, thus:

$$\begin{pmatrix} R \\ G \\ B \end{pmatrix} = \underline{M} . \begin{pmatrix} Y \\ U \\ V \end{pmatrix}$$

[Note: If you are more familiar with the YIQ model you may treat the YUV model as identical for the purposes of this question.]

i) Describe the components in the YUV colour difference model. **(4 marks)**

ii) Explain, giving your reasons, which elements of the mapping, <u>M</u>, you would expect to be positive and which negative. **(5 marks)**

b) Colour models such as YUV and RGB are unsatisfactory from the point of view of a user trying to select a colour.

i) Why is this? **(4 marks)**

ii) Describe a colour model which would be more intuitive for such a user. **(4 marks)**

c) A colour inkjet printer with a separate nozzle for black is to be used to produce hard copies of the images displayed on the PC's monitor.

i) Describe a suitable colour model for the printer. **(3 marks)**

ii) How would a colour defined in the monitor's RGB model be converted to the printer's model?

(5 marks)

Turn over]

3. Efficient and effective scan conversion algorithms are required to implement a drawing package. For each of the following drawing components address issues of computational efficiency and visual acceptability.

a) A horizontal straight line and a straight line with gradient 1 are displayed using the basic scan conversion algorithm. Explain why the two lines have different intensities when they are displayed using the same number of pixels. Give two mechanisms which can be used to display the two lines with equal intensity.
(9 marks)

b) A circle is centred at (0,0). Using considerations of symmetry show that a pixel at the co-ordinate point (x,y) which lies on the circle can be used to generate another 7 pixels which also lie on the circle.
(7 marks)

Which values of x and y cannot be used to generate 7 additional pixels in this way? Give the reasons why and show which additional pixels can be generated from these pixels.
(9 marks)

4. a) Describe the iterative evaluation method for displaying a parametric cubic spline segment in two dimensions. Give the number of multiplications and the number of additions required to calculate each co-ordinate pair.
(8 marks)

b) Explain how forward differences can be applied to the calculation of cubic spline segments to reduce the number of calculations. Give the number of multiplications and the number of additions required to calculate each coordinate pair.
(8 marks)

c) Describe the Bezier form for generating cubic spline segments, identifying each of the control points and their purpose. What are the requirements to make two Bezier spline segments C1 continuous?
(9 marks)

5. a) Describe the functionality of an X server in an X Windows system. What information is transmitted between an X server and an X client?
(12 marks)

b) What is the default security mechanism which is used to decide whether or not an X server will communicate with a client? What are the three mechanisms which can be used to change X security?
(13 marks)