THE UNIVERSITY
of LIVERPOOL

JANUARY 2007 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Engineering : Year 3
Bachelor of Science : Year 3
Bachelor of Science : Year 4
Master of Engineering : Year 3
Master of Engineering : Year 4
No qualification aimed for : Year 1

COMP307 : IMAGE PROCESSING, COMPUTER VISION, AND GRAPHICS

TIME ALLOWED : TWO HOURS AND A HALF

INSTRUCTIONS TO CANDIDATES

SECTION A: ANSWER ALL QUESTIONS
               (Section A is worth 50%)

SECTION B: ANSWER 2 OUT OF 4 QUESTIONS
               (25 marks for each answer; Section B is worth 50%)

If you attempt to answer more than the required number of questions in Section B, the marks awarded for the excess questions will be discarded starting with the lowest mark.

Section A

Answer ALL questions in Section A. Section A is worth 50% of the marks available.

A1

What in computer graphics are *drawing primitives* and what is the importance of *bundled attributes*?

(5 marks)

A2

In image processing what is meant by salt and pepper imperfection? Describe one way in which such imperfections may be removed.

(5 marks)

A3

Using a simple sketch, outline where in the human vision system the *fovea centralis* might be found? What features of this area mark it out as special?

(5 marks)

A4

Illustrate the result of using translational and rotational sweep methods to generate solid objects from the 2D area illustrated below in Figure 1.
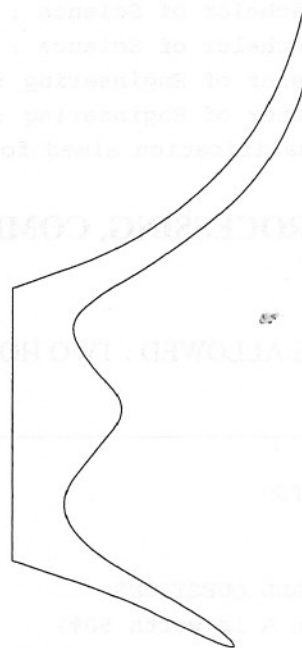
(5 marks)

Figure 1

A5

In image processing contrast *components*, *regions*, and *segments*.

(5 marks)

A6

A wireframe cube aligned with the axes has its centroid at x=1.0, y=1.0, and z=1.0. Describe how you would turn this cube about its centroid by 45 degrees in each axis direction.

(5 marks)

A7

What is the relationship between the CIE chromaticity diagram and a *colour gamut*? Where in computer graphics might a *colour gamut* be used?

(5 marks)

A8

Illustrate G^0 and G^1 geometric curve segment continuity over a join point and explain how they are different.

(5 marks)

A9

In computer graphics what is a viewport? Using a graphics system you are familiar with, describe the code you would use to define one.

(5 marks)

A10

Briefly describe how *sprite animation* is achieved.

(5 marks)

Section B

Answer 2 questions in Section B. Section B is worth 50% of the marks available.

B1

(a) You are retained as the graphics consultant by a company seeking to sell kitchen taps on national television. Describe briefly the issues and concerns you are likely to encounter, commenting especially on the appropriateness of computer graphics for such an application.

(10 marks)

(b) Which graphics pipeline might be the most appropriate to use if cost of the advertisement in (a) above were not a major issue?

(15 marks)

B2

1	2	3
8	0	4
7	6	5

Figure 2

(a) Given the $[4^4]$ tiling and tile labels found in Figure 2 sketch the the resulting tiling hierarchy and explain whether it would be *bounded* or not. What labelling would generate a 2-bounded structure?

(7 marks)

(b) Based on the tiling and addressing found in Figure 1 develop a tesseral addition table for it.

(10 marks)

(d) Is tesseral subtraction necessary with the addressing system developed in (b)? Explain your answer by considering the tesseral sums 52 + 4, 52 - 4 and 52 + 8.

(8 marks)

B3

(a) Describe the Craik-Consweet-O'Brien optical illusion and outline a plausible explanation for it.

(15 marks)

(b) Why should the designers of image rendering algorithms be concerned with this visual phenomenon?

(10 marks)

B4

(a) Describe the key features of the following Postscript program and sketch the output it generates.

```
%!
% Example PostScript Program

/inch {72 mul} def
/obj
  { newpath
    0.0  1.0 moveto
  -0.5 -0.5 lineto
    0.5 -0.5 lineto
    closepath
  } def

gsave
 2.5 inch 6 inch translate
 1 25 div setlinewidth
 1 1 5
   { gsave
      .5 mul inch dup scale
      obj
      stroke
     grestore
   } for
grestore

showpage
```

(10 marks)

(b) Using an imperative programming language such as C, and calls to a graphical procedure library with which you are familiar, sketch a program that produces similar output.

(15 marks)

B5

(a)   Contrast the key features of a programming language approach, a procedural approach, and an applications package approach to computer graphics.

(15 marks)

(b)   You have two tasks, to design a simple christmas card and to design a new logo for a university student organisation. Explain fully which approach you would choose to use, and what your concerns might be in completing each task.

(10 marks)