Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

GX 2083

Semester 1 Examinations, 2005

Exam Code(s)	4IF1, 4BP1
Exam(s)	4th Year B.Sc. (Information Technology) 4th Year B.E. (Electronic & Computer Engineering)
Module Code(s)	CT404
Module(s)	GRAPHICS AND IMAGE PROCESSING
Paper No.	1
Repeat Paper	Special Paper
External Examiner(s)	Prof. J. Keane
Internal Examiner(s)	Dr. M. Madden Dr. S. Redfern

Instructions:

Time allowed: **2** hours
Answer any **3** questions

All questions carry equal marks.

Duration	2 hrs
No. of Answer books	1
Requirements:	
Handout	
MCQ	
Statistical Tables	
Graph Paper	
Log Graph Paper	
Other Material	
No. of Pages	5
Department(s)	Information Technology

Q.1.

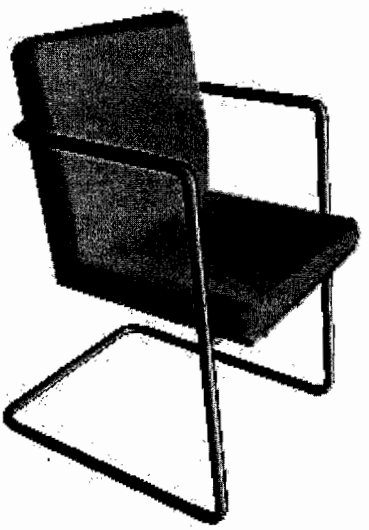
Real-time 3D graphics programmers use a variety of techniques to improve the realism of their virtual worlds while keeping the number of polygons actually being rendered to a minimum. Discuss the techniques that are currently used. *(20 marks).*

Q.2.

(a) With respect to the digital storage of raster (bitmapped) graphics, explain the differences between "lossless" compression and "lossy" compression. Briefly outline the dictionary-based compression algorithm used in GIF image files. What characteristics would you expect to see in an image that is highly suitable for GIF compression? *(5 marks).*

(b) Describe the raster graphics technique of "antialiasing", referring to both "weighted area sampling" and "unweighted area sampling" in your answer. *(5 marks).*

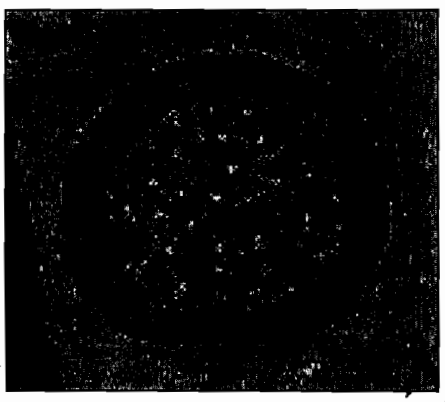
(c) The model pictured on the right is of an office chair. Write VRML code to create an object similar to this. Your code should specify materials as well as geometry. *(10 marks).*

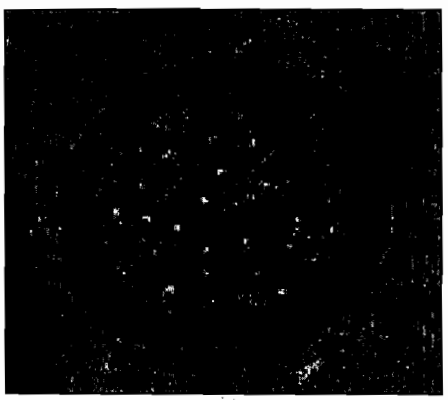


Hint: the tubular component that makes up the legs and arms of the chair could be created by extruding a circular cross-section through a complex 3D path. Note that the most useful VRML nodes are summarised on the final page of this exam paper.

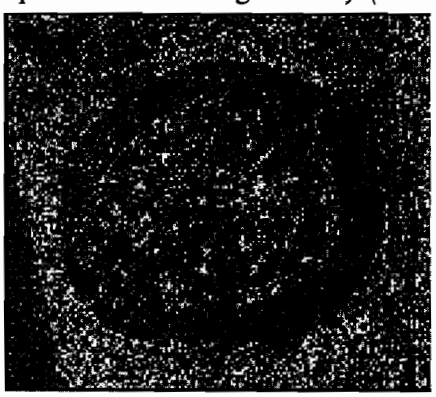
Q.3.

(a) The first two images pictured below represent the left and right components of a stereo pair. **Outline** and **discuss** an algorithm for estimating the distance that each pixel in the left image is from the camera. *(15 marks).*





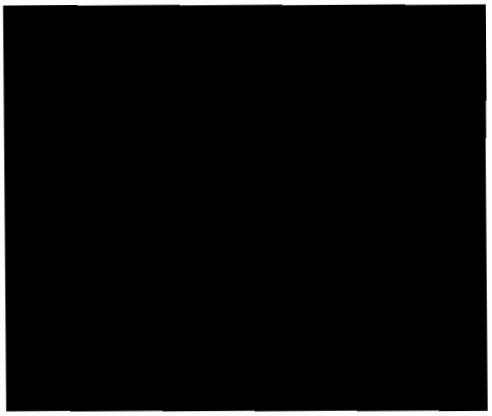
(b) Explain how the algorithm you have outlined might be extended in order to robustly deal with noise (such as that present in the image below). *(5 marks).*



Q.4.

(a) Many automatic image analysis algorithms begin by smoothing an image, and then applying an edge extraction filter in order to ascertain the evidence for the edges of objects in the image. (i) Discuss the use of smoothing and edge detection for these purposes. (ii) Discuss some approaches that might be used to deal with problems such as fragmentary edges and occluded edges. *(10 marks).*

(b) (i) Discuss the image processing technique called 'active contours'. (ii) Present a suitable set of optimisation constraints (sometimes called energy factors) for accurately tracing the outline of a hand in an image such as the one shown below, using active contours. *(10 marks).*



Q.5.

(a) Describe the morphological techniques of erosion and dilation. Compare the four operations (i) opening, (ii) closing, (iii) thinning and (iv) thickening. In what circumstances might each of these four operations be used? *(10 marks).*

(b) The image on the right is of a printed circuit board (PCB), thousands of which are manufactured every hour in a particular factory. It is required as part of the quality control of this factory to produce an automatic machine vision system, which extracts the traces (straight bits), end points (places at which a trace terminates), and pads (circular bits) in the image. **Present** and **discuss** a suitable and robust set of image processing algorithms for this task *(10 marks).*