DUBLIN CITY UNIVERSITY

Sample Paper

MODULE: ***(Title & Code)***	Computer Graphics CA417
COURSE:	B.Sc. in Computer Applications (CASE) B.Sc. in Computer Applications (CAIS)
YEAR:	4
EXAMINERS:	Dr. David Sinclair
TIME ALLOWED:	2 Hours
INSTRUCTIONS:	Please answer 3 questions. All questions carry equal marks

THE USE OF PROGRAMMABLE OR TEXT STORING CALCULATORS IS EXPRESSLY FORBIDDEN

Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

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Question 1

1(a)	What is the role of capabilities in Java3D?	[5 marks]
1(b)	Describe the different geometry arrays in Java3D.	[14 marks]
1(c)	Write a small Java3D program that defines a pyramid in a scene graph using an indexed geometry.	[14 marks]

[Total marks: 33]

Question 2

2(a)	In *ray tracing*, what is an **eye ray**?	[4 marks]
2(b)	Describe an efficient method for calculating the intersection of an eye ray and a sphere. Use a parametric representation of the eye ray.	[10 marks]
2(c)	Write the pseudo-code for a recursive ray tracing algorithm.	[15 marks]
2(d)	Classic optimisations used in visible surface determination cannot be used in recursive ray tracing. Why?	[4 marks]

[Total marks: 33]

Question 3

3(a)	Describe the role of **clipping** in the graphics pipeline.	[6 marks]
3(b)	Describe the Cohen-Sutherland clipping algorithm in two dimensions.	[12 marks]
3(c)	Show how the Cohen-Sutherland algorithm can be extended to deal with normalised perspective projection in three dimensions.	[10 marks]
3(d)	What is the key inefficiency of the Cohen-Sutherland algorithm?	[5 marks]

[Total marks: 33]

Question 4

4(a)	Describe a vector cross-product in three dimensional space.	[5 marks]
4(b)	Describe parallel and perspective projection.	[6 marks]
4(c)	Calculate the transformation matrix for perspective projection where the view plane is defined by a its reference point $[0,1,0]^T$ and its normal $[0,0,1]^T$. The viewing window is defined by minimum and maximum (u,v) values of (0,0) and (200,300) respectively. The viewing point is located at $[-2,2,10]^T$ and its up-vector is $[0,1,0]^T$. The front and back clipping planes are z=2 and z=-5 respectively.	[12 marks]
4(d)	Apply the transformation matrix derived in part (b) to a cube centred on the origin and whose side are of length 2.	[10 marks]

[Total marks: 33]