Paper CODE	EXAMINER	DEPARTMENT	TEL
CPT205		Computing	

1st SEMESTER 2021/22 FINAL EXAMINATION

Undergraduate – Year 3

COMPUTER GRAPHICS

TIME ALLOWED: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. **This is a closed-book examination, which is to be written without books or notes.**
2. **Total marks available are 100.**
3. **Answer ALL questions in this examination. It is not necessary to copy the questions into the answer booklet.**
4. **Answer should be written in the answer booklet(s) provided.**
5. **Only solutions in English are accepted.**
6. **All materials must be returned to the exam supervisor upon completion of the exam. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.**

Question 1. Fundamentals [Total 20 marks]

1.1. How is screen resolution defined in computer graphics? [2 marks]

1.2. Briefly explain gl, glu and glut functions in OpenGL. [2 marks]

1.3. List at least four input devices used with computer graphics applications. [2 marks]

1.4. Calculate the unit vector of **V** = 3**i** - 4**j**. [2 marks]

1.5. Explain why 4x4 matrices are used to process 3D transformations in computer graphics. [2 marks]

1.6. Explain any restriction to the value of the homogeneous parameter used in homogeneous co-ordinates. [2 marks]

1.7. How can an object in 2D be mirrored about the co-ordinate system origin? [2 marks]

1.8. What does the **glClearClear(1.0, 1.0, 1.0, 1.0)** do in OpenGL do? [2 marks]

1.9. Explain the concept of texture mapping in computer graphics. [2 marks]

1.10. Decide which of the following processes are involved in hidden surface removal; write down your answer in the answer book provided. [2 marks]

a) Culling
b) Depth buffering
c) Double buffering
d) Z-buffering

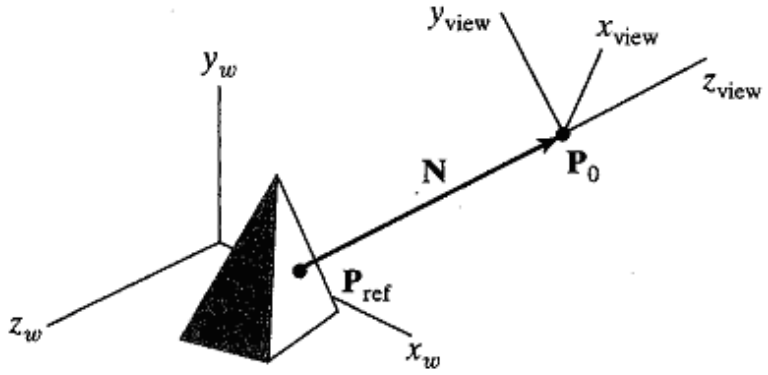
Question 2. Transformation and viewing [Total 20 marks]

2.1. An object is rotated about an axis (0.0, 0.0, 1.0) by 30° at a fixed point of (3.0, -2.0, 1.0). [8 marks]

a) Find the transformation matrices as a set of matrix multiplications,

b) Write OpenGL code for the transformations.

2.2. There are several co-ordinate parameters for 3D viewing such as viewing origin (or camera position) P0, reference point (or look-at point) Pref, viewing direction N, and viewing co-ordinate system (as shown below). Describe how the viewing co-ordinate system can be defined. Diagrams can be used in your answer where necessary. [6 marks]



2.3. There are concerns about the placement of the viewing plane for a frustum perspective projection. Explain

a) If there is any restriction on the placement of the viewing plane, and

b) effect of the placement of the viewing plane on the on object display.

Diagrams can be used in your answer where necessary. [6 marks]

Question 3. Creation and representation of geometry [Total 20 marks]

3.1. Briefly explain the types of continuity that can be enforced at the joint of a Spline curve. [4 marks]

3.2. Briefly describe and compare wireframe, surface and solid models including their strengths, drawbacks and applications. [8 marks]

3.3. Explain what the following OpenGL code does, referring to lines of the code where necessary. [8 marks]

```
01      glBegin(GL_QUADS);
02      for (A = 0; A < 2pi; A = +DA) {
03          glVertex3f(R*cos(A), R*sin(A), 0);
04          glVertex3f(R*cos(A+DA), R*sin(A+DA), 0);
05          glVertex3f(R*cos(A+DA), R*sin(A+DA), H);
06          glVertex3f(R*cos(A), R*sin(A), H);
07          }
08      glEnd();
09
10      glBegin(GL_POLYGON);
11      for (A = 0; A < 2pi; A = +DA)
12          glVertex3f(R*cos(A), R*sin(A), 0);
13      glEnd();
14
15      glBegin(GL_POLYGON);
16      for (A = 0; A < 2pi; A = +DA)
17          glVertex3f(R*cos(A), R*sin(A), H);
18      glEnd();
```

Question 4. Lighting and texture mapping [Total 20 marks]

4.1. Explain the point and directional light sources. Which of these light sources would benefit from having attenuation of light strength applied and why? [8 marks]

4.2. Given a light source (0.8, 0.6, 0.2) and a material (0.0, 1.0, 0.5), work out the combined effect. [2 marks]

4.3. Briefly explain the concepts of magnification and minification. Diagrams can be used in your answer where necessary. [5 marks]

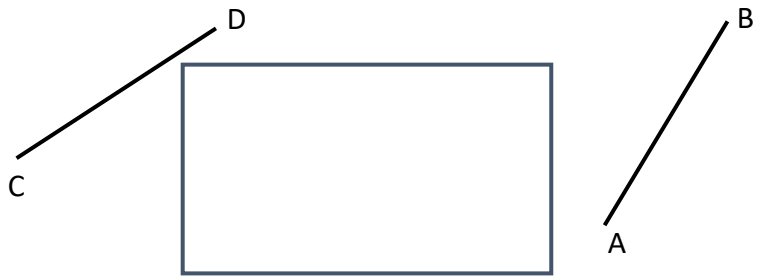
4.4. Explain second mapping in texture mapping and provide an example of the methods for implementation. [5 marks]

Question 5. Clipping and hidden surface removal [Total 20 marks]

5.1. Provide your answer to the following two questions about the Cohen-Sutherland line clipping algorithm. Diagrams can be used in your answer where necessary. [8 marks]

a) Explain how the Cohen-Sutherland algorithm could be extended from 2D to 3D space.

b) The following figure shows two lines and a rectangular clipping window. Describe the steps of clips that the Cohen-Sutherland algorithm would perform for each of these lines.



5.2. Explain the painter's method for hidden surface removal and the main problems with this method. Diagrams can be used in your answer where necessary. [6 marks]

5.3. Describe the z-buffer method for hidden surface removal. [6 marks]

THIS IS THE END OF THE EXAM.