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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

COURSE NAME : COMPUTER GRAPHICS
COURSE CODE : BIM 20603
PROGRAMME CODE : BIM
EXAMINATION DATE : FEBRUARY 2023
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1**
- (a) Describe **THREE (3)** attributes of creating a 3D world. (6 marks)
 - (b) List down functions for both orthographic and perspective projections in OpenGL. (4 marks)
 - (c) You are required to scale down a tetrahedron by $S_x = -3$, $S_y = -7$, and $S_z = -11$. Given that x , y , and z of one of the vertex points of the tetrahedron are 23, 15, and 46, respectively, demonstrate the 3D scaling equation of one point of this object, based on these values. (4 marks)
 - (d) Construct a scene graph of a drone using a directed acyclic graph (DAG). (6 marks)

- Q2**
- (a) **Figure Q2** depicts an example of a trapezoidal shape. Enumerate all surfaces that comprise the visible faces of this polygon. (6 marks)

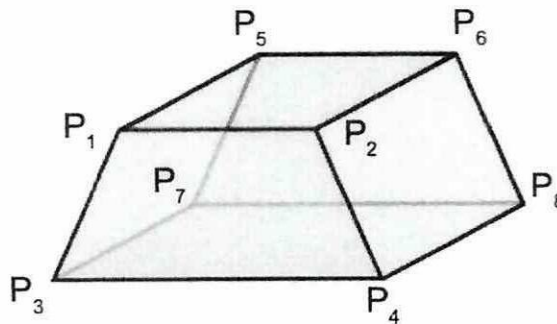


Figure Q2

- (b) Write OpenGL functions for constructing a wire torus and solid sphere. (4 marks)
- (c) Polygonal-based techniques manipulate vertices, edges, and polygons to create complex objects from simple 3D geometric objects. Describe **FIVE (5)** operations related to these techniques. (5 marks)

- (d) Determine the cross product of the 3D vectors $p = [-8, 7, 16]$ and $q = [26, -8, -9]$.
(5 marks)

Q3 In computer graphics, the process of clipping involves removing portions of an image that are either inside or outside of a defined viewing region.

- (a) Outline the fundamental procedures required to achieve 3D clipping.
(4 marks)
- (b) What justifies the need for clipping?
(4 marks)
- (c) Draw and identify (label) the clipping volume for both perspective and orthographic projections with the relevant object placements.
(6 marks)
- (d) Describe the common problems associated with clipping.
(4 marks)

Q4 (a) Describe the local illumination model and the three constituents of the Phong reflection model.
(5 marks)

- (b) What distinguishes Phong shading from Gouraud shading? You must provide diagrams or figures to support your answer.
(5 marks)
- (c) What are the differences between shadow volumes and shadow maps? Diagram and illustration are required to support your answer.
(5 marks)
- (d) Clarify in your own words the significance of ray tracing.
(5 marks)

Q5 CodeBlocks-OpenGL is able to create both 2D and 3D computer graphics, including object and environment lighting, shadings, shadows, and textures.

(a) Explain the purpose of each of these command lines:

(i) `#include "imageloader.h"`

(ii) `GLuint loadTexture(Image* image)`

(iii) `glGenTextures(1, &textureId);`

(iv) `glBindTexture(GL_TEXTURE_2D, textureId);`

(5 marks)

(b) Write down a function code for drawing a triangle with a texture map. Your answer should include a random color configuration of the triangle, a scale size of 1.7, a translation of 5.5 and -3 in x- and y-direction, respectively, and the triangle size of your preference.

(10 marks)

(c) **Q5(a)** and **Q5(b)** are part of coding lines and functions for texture mapping an image to a 2D object. Specify a procedure for displaying a 3D cube with texture mapping applied to its surfaces.

(5 marks)

- END OF QUESTIONS -

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