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B.Sc. Engg. CSE 5th Semester 12 March 2019 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **WINTER SEMESTER, 2018-2019**

DURATION: 1 Hour 30 Minutes **FULL MARKS: 75**

CSE 4551: Computer Graphics and Multimedia

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) Differentiate between vector display hardware and raster displays. What is the main limitation when displaying an image through raster display? 5

   b) Discuss geometry-based graphics and sample-based graphics in detail. Write down the benefits and limitations of a sample-based system. 10

   c) What is a projection in the context of computer graphics and linear algebra? What does a cross product between two vectors imply? 5

   d) Explain linearly independent vectors with the aid of an example. Do two vectors necessarily have to be perpendicular in order to be linearly independent? 5

2. a) For an application, a rectangular window with a bottom left co-ordinate of (2,5), and of length 21 units and width 9 units, needs to be transformed to fit a rectangular viewport. The viewport has a top-right co-ordinate of (9,7) and a length of 5 units and a width of 4 units. The window and viewport are illustrated below. Write down the sequence of matrices, in the correct order, for this transformation. Describe what each matrix is performing. 8

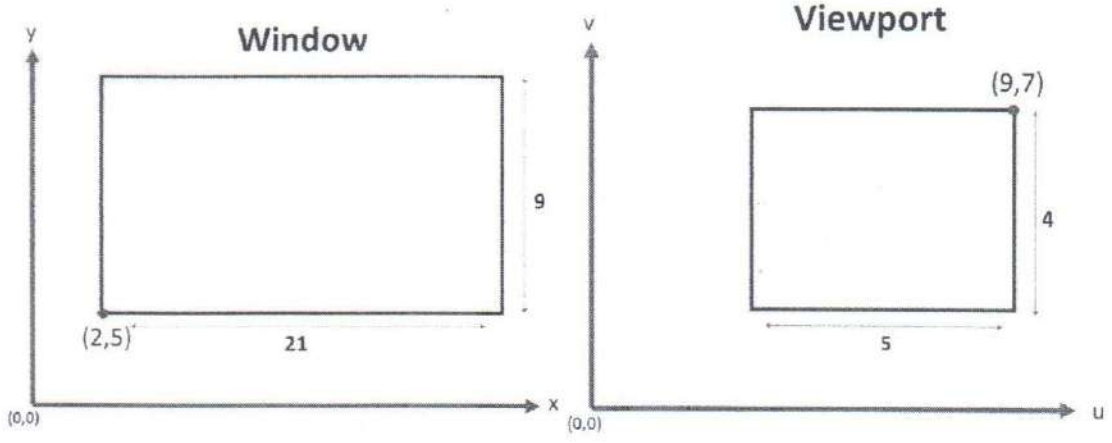

Figure 1: The window and viewport in their own respective co-ordinate systems

   b) Suppose you want to scale an object about any arbitrary point in 2D. Assume that this arbitrary point has co-ordinate (X_p, Y_p). Assume also that the scale factors are S_x and S_Y along the x and y directions, respectively. Find a single, final matrix that does this, when it is multiplied to the object's co-ordinates. 5

   c) What are splines? Briefly discuss Hermite Curves, with a suitable diagram to show the four pieces of information that determine these curves. 4

d) Derive the parameterized equation of a Cubic Hermite curve. For your convenience, the Hermite basis matrix is given below: 8

$$\begin{vmatrix} 2 & -2 & 1 & 1 \\ -3 & 3 & -2 & -1 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{vmatrix}$$

3. a) A cube is to be rotated 90 degrees in 3D, about a vector defined by the endpoints (4, 2, 0) and (6, 6, 2). Write down the correct sequence of matrix transformations to achieve this, including all of the intermediate translations and rotations. Explain, very briefly, the role of each matrix. When performing this rotation, make sure that the vector is transformed such that it coincides with the z-axis via the x-z plane. 20

b) Explain the mathematical rules that must be satisfied for a transformation to be classified as linear. Provide evidence as to why translation is not a linear transformation. 5

4. a) What is scan conversion? What are some of the drawbacks of the basic line drawing algorithm? 5

b) Derive, from the very beginning, the generalized values for d_{start}, ΔE, and ΔNE in the midpoint line algorithm. 10

c) Using the midpoint line algorithm, draw a line from (20,10) to (30,18). Write down all of the intermediate points that would make up the line, from the given start and end points. 10