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

ONLINE WRITTEN ASSESSMENT **WINTER SEMESTER, 2019-2020**

DURATION: 1 Hour 20 Minutes **FULL MARKS: 40**

CSE 4551: Computer Graphics and Multimedia Systems

Submit the answers of all the questions together upon completion of the exam. The images of the answer script must be clearly readable and in sequence.

There are 5 **(five)** questions. Answer any 4 **(four)** of them.

Figures in the right margin indicate marks.

---

1. a) Suppose for a 2D viewport, the window is defined by the coordinates $(x_{min}, y_{min}) = (2,2)$ and $(x_{max}, y_{max}) = (4,4)$. Suppose there is a line object in this scene whose endpoints are $(x_1, y_1) = (1, p)$ and $(x_2, y_2) = (q, 1)$ where p and q are obtained respectively as the first and second digit of the last two digits of your student ID. For example, if the last two digits of your student ID is 35, then the line endpoints are $(x_1, y_1) = (1,3)$ and $(x_2, y_2) = (5,1)$. Draw the clipping window and the line based on your obtained coordinates and apply the Cohen-Sutherland Line Clipping algorithm on this to determine the clipping points. Show the calculations along with the application of TBRL code checks. Also mention how the algorithm determines the stopping criteria (that is, how it will know that it should stop here). 10

2. a) Suppose you are watching a video clip on a color CRT monitor of resolution 1366×768. It uses the RGB 24 bit color scheme and has a frame rate of 60 Hz. The length of the video clip (in minutes) is equal to the last two digits of your student ID. For example, if the last two digits of your ID is 35 then the length of the video clip is 35 minutes long. Now calculate the following for this video clip (show your calculations): 6

   i. The size of the video clip.

   ii. The total number of times horizontal retrace is performed while showing the video for that duration.

   iii. The total number of times vertical retrace is performed while showing the video for that duration.

   b) Describe the different types of light sources used in graphical systems. In which kind of scenario would each of them be useful? 4

3. a) Suppose the incident ray vector is $I = \begin{bmatrix} \frac{1}{\sqrt{5}} \\ \frac{2}{\sqrt{5}} \end{bmatrix}$ and the normal vector is $N = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Now suppose the relative index of refraction of the material is $\eta = 1 \cdot xy$, where the two digits after decimal point (denoted as x and y) are found as the last two digits of your student ID. For example if the last two digits of your ID is 35 then the relative index of refraction is $1 \cdot 35$. Assuming that the incident ray hit the surface of such a refractive material, determine the refracted ray vector T. 6

   b) Describe an application of CSG. How is it implemented for a graphical system?. 4

4. a) Suppose the camera is at (0,0,0) and a ray is cast from the camera towards the scene through the (x, y) pixel of the view plane. The x and y coordinates are obtained from the last two digits of your student ID. For example, if your ID is 35 then the ray will pass through the pixel p = (3, 5). Suppose the aspect ratio of the viewport is 16:9 and the Field of View (FOV) is defined as 60. And the basis vectors of the view coordinate system are defined as $\boldsymbol{u} = \begin{bmatrix}1\\0\\0\end{bmatrix}$, $\boldsymbol{v} = \begin{bmatrix}0\\1\\0\end{bmatrix}$ and $\boldsymbol{w} = \begin{bmatrix}0\\0\\1\end{bmatrix}$. Now find the explicit ray representation for the given ray (Note that this is for the 3D case). 6

b) What is the benefit of representing hierarchical model of a scene using the Directed Acyclic Graph (DAG) data structure? Explain how hierarchical modelling helps in animation. 4

5 a) The CIE XYZ color space is alternately specified as xyY color space since the three values of x, y and Y can be used to derive the rest of the tristimulus values X and Z. Here (x, y) refers to the chromaticity where $0 \leq x, y \leq 1$, while Y refers to the Luminance which can be from 0 to 100. Suppose (x, y) = (0.3, 0.5) and Y is equivalent to the value formed by the last two digits of your student ID. For example, if the last two digits of your ID is 35 then Y=35. Now find the other tristimulus values X and Z (show all the calculations). 5

b) Draw two separate objects (suppose two stick figures) that have collision in some part and show (using step-by-step figures) how the Hierarchical Collision Testing would work on them. Assume that the Collision Hierarchy is defined upto depth 2, that is each of the objects have their own bounding spheres around the whole object, and inside each bounding sphere, there are individual bounding spheres for their body parts (such as Head, Torso, Arms and Legs). 5