M.Sc./II Sem. - 2014

INFORMATICS - Paper IT-25

Computer Graphics and Multimedia

Time: 3 hours *Maximum Marks: 75*

(Write your Roll No. on the top immediately on receipt of this question paper)

Attempt five questions in all. Question No. **1** *is compulsory*

Q.1(a) What is an image 's aspect ratio?

(b) If we want to cut a 512×512 sub-image out from the center of an 800×600 image, what are the coordinates of the pixel in the large image that is at the lower left corner of the small image?

(c) If we use direct coding of RGB values with 2 bits primary color, how many possible colors do we have for each pixel?

(d) What do you call the path the electron beam takes when returning to the left side of the CRT screen?

(e) What is the pitch of a color CRT?

(f) Show that $1 + 254 \times count/N$ provides a proportional mapping from count in $[0, N]$ to c in $[1, 255]$.

(g) Can a $5 \times 3\frac{1}{2}$ inch image be presented at 6×4 inch without introducing geometric distortion?

(h) The frame buffer is a digital device and raster CRT is an analog device. How do we convert the digital information from the frame buffer on to the raster as a picture?

(i) What is the access rate/pixel of a 4096×4096 raster having a refresh rate of 30 frames/sec.?

(j) How many bits are required for a 512×512 raster with each pixel being represented by 3 bits?

(15)

Q.2(a) What do you understand by scan-conversion of (i) a line and (ii) a circle? (5)

(b) Describe the Bresenham's circle algorithm. (5)

(c) Use pseudo-code to describe the steps that are required to plot a line whose slope is between $45°$ and $-45°$ using the slope -intercept equation. (5)

Q.3(a) Write the steps required to scan-convert a circle using trigonometric method. (5)

(b) Write down the matrix to represent a point (x, y). If the transformation matrix is $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, find the values of the transformed co-ordinates of the point (x, y). Using suitable values of the elements of transformation matrix, sketch the transformation of a point $P(x, y)$ due to scaling and reflection. (5)

(c) Consider the line AB with position vectors of the end points $A = [0 \quad 1]$ and $B = [2 \quad 3]$. Using the transformation matrix $[T] = \begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$, find the mid points of the transformed line A^*B^*. (5)

Q.4(a) Equation of two intersecting lines AB and EF are $-(2/3)x + y = -(1/3)$ and $x + y = 1$ respectively. Write the matrix form of these lines. If these lines get transformed using $T = \begin{bmatrix} 1 & 2 \\ -1 & -3 \end{bmatrix}$, show that the intersection point of the untransformed lines and the intersection point of the transformed lines are identical. (5)

(b) Show that the transformation for a general rotation about the origin by an arbitrary angle is (5)

$$[T] = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

3+4

(c) Consider a triangle DEF with position vectors $D = [8 \quad 1]$, $E = [7 \quad 3]$ and $F = [6 \quad 2]$ respectively. If the reflection is considered about $y = 0$, the x-axis, find the new position vectors. Also find the position vectors, if the triangle DEF is rotated about the line $y = x$. (5)

-4+3

-1

Q.5(a) Consider a triangle ABC with position vectors $A = [-1 \quad -1]$, $B = [2 \quad -1]$ and $C = [-1 \quad 2]$. If it is first rotated about the origin by 90° and subsequently reflected through the line $y = -x$, what will be the resulting new position vectors. $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ (5) $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$

(b) Deduce the conditions under which the angle between two intersecting lines remain unchanged under a transformation $t = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. (2)

(c) What do you understand by homogeneous transformation? An object has the center at $[4 \quad 3]$. If the object is rotated by 90° counterclockwise about its center, what will be the new coordinates of a point $P(x, y)$ on the object. (5)

Q.6(a) A rectangular parallelepiped(RPP), $ABCDFGH$,is defined in terms of the following matrix representation

$\frac{8}{\sqrt{2}} \quad \frac{-1}{\sqrt{2}}$

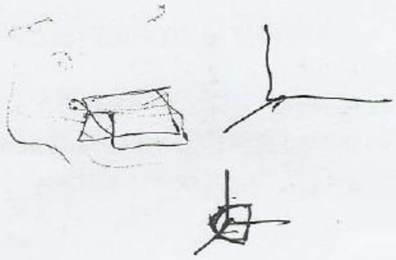
$-6+2+\sqrt{3}+4-\sqrt{3}$

$\frac{-3}{2\sqrt{2}}$

$2\sqrt{3}-1+1-\sqrt{3}$.

$$\begin{bmatrix} 1/2 & 0 & 0 & 0 \\ 0 & 1/3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 1 \\ 2 & 0 & 1 \\ 2 & 3 & 1 \\ 0 & 3 & 1 \\ 0 & 0 & 0 \\ 2 & 0 & 0 \\ 2 & 3 & 0 \\ 0 & 3 & 0 \end{bmatrix}$$



Find the transformation matrix to scale the RPP to yield a cube. Also find the homogeneous position vectors of the resulting cube. (4)

(b) Write the homogeneous co-ordinate transformation matrix for the rotation about (i) x-axis by θ,(ii) y-axis by ψ and z-axis by ϕ. The homogeneous coordinate position vector is given as $[3 \quad 2 \quad 1 \quad 1]$. Find the new position vectors if there is a translation in the x, y, z-directions by $-1, -1, -1$ respectively followed by successively by a $+30°$ rotation about the x-axis, and a rotation $+45°$ about the y-axis... (8)

(c) Find a transformation T which aligns a given vector V with the vector $\hat{k}$ along the z-axis. (3)

$\frac{3}{\sqrt{2}}+\frac{2}{2\sqrt{2}}+\frac{\sqrt{3}}{2\sqrt{2}}$

$-\frac{\sqrt{3}}{2}+\frac{1}{2}$

$\frac{2}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}-\frac{\sqrt{3}}{2\sqrt{2}}$

$\frac{2}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}\ \frac{\sqrt{3}}{2\sqrt{2}}$

$\frac{1-\sqrt{3}}{2\sqrt{2}}$

$-\frac{3\sqrt{3}}{2\sqrt{2}}$