Computer graphics

Unit 3

Q.1) Explain 3D reflection about XY, YZ & XZ plane.

⟹ (i) Reflection about the XY plane :

- Plane : XY plane (where $z = 0$)
- Effect : flips the z-coordinate, keeps X & Y the same.
- Result : A point (x, y, z) becomes $(x, y, -z)$.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

(ii) Reflection about the YZ plane

- Plane : YZ plane (where $x = 0$)
- Effect : flips the x-co-ordinate, keeps Y & Z the same.
- Result : A point (x, y, z) becomes $(-x, y, z)$.

$$\begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

(iii) Reflection about the XZ plane :

- Plane : XZ plane (where $y = 0$)
- Effect : flips the y-coordinate, keeps X & Z the same.
- Result : A point (x, y, z) becomes $(x, -y, z)$.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

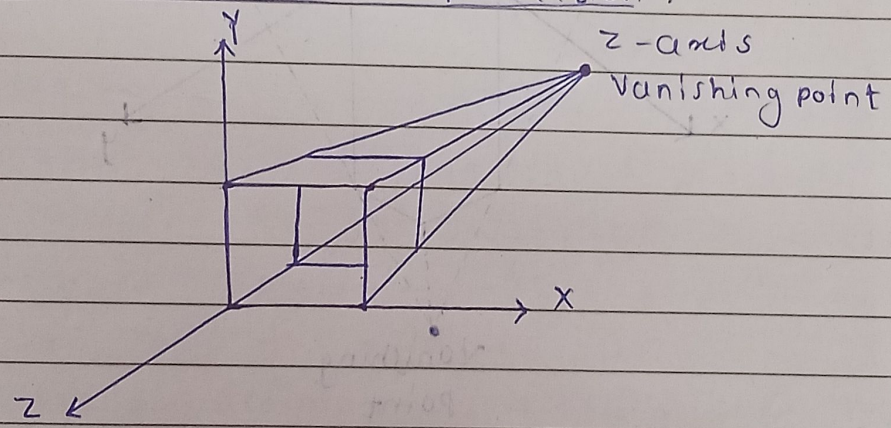
Q. (2) What is projection? Explain with diagram, perspective projection with vanishing points as 1 point, 2 point & 3 point?

⟹ - Projection is the method of displaying 3D objects on a 2D screen.
- It helps represent the depth and position of objects in a scene.

• Types
(i) Orthographic projection.
(ii) perspective projection.

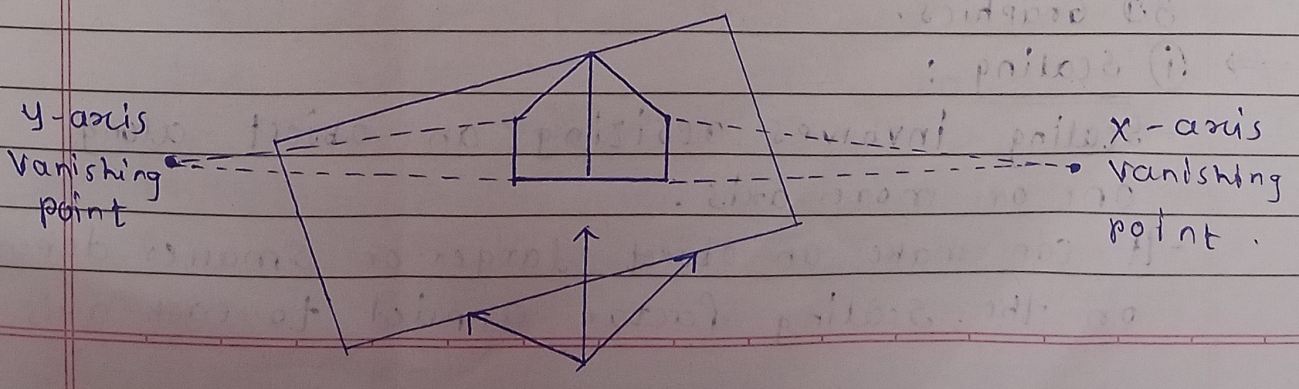
• perspective projection types:

(i) One point perspective projection:



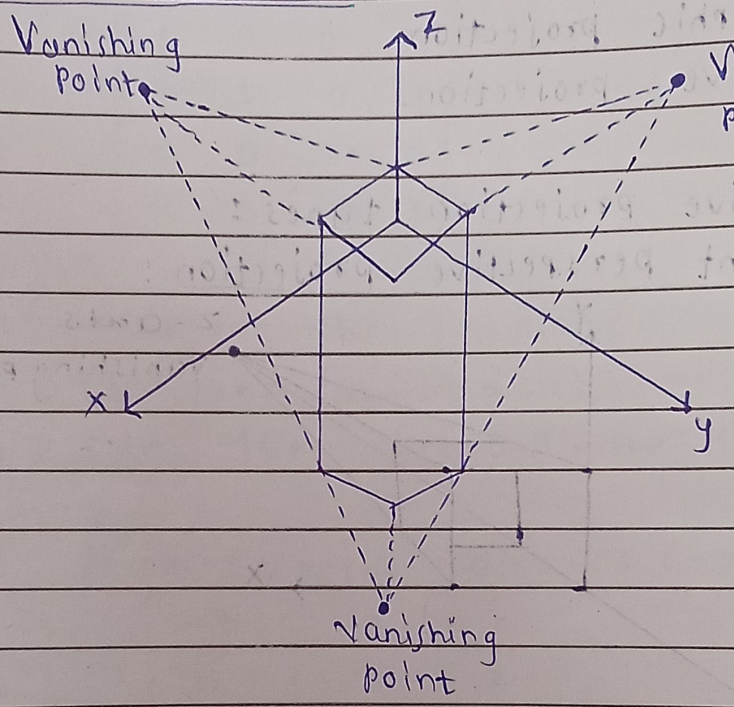
- Uses one vanishing point.
- where all lines parallel to the viewer's line of sight converge.
- objects directly facing the viewer, such as a straight road or a hallway.

(ii) 2-point perspective:



- 2-point perspective uses two vanishing points.
- it occurs when projection plane intersects two of principal axis.
- In fig, projection plane intersects x & y axis whereas z axis remains parallel to projection plane.

(iii) 3-point perspective :



- Uses three vanishing points.
- It occurs when all three axis intersects with projection plane.
- There is no any principal axis which is parallel to projection plane.

Q.3) Explain the basic transformation techniques in 3D Graphics.

⟹ (i) Scaling :

- Scaling involves resizing an object along one or more axis.
- It can make an object larger or smaller depending on the scaling factor applied to each axis.

(ii) Rotation :
- It involves rotating an object around a fixed point or axis in 3D space.
- It can be performed around any axis, such as x, y or z & at any angle.

(iii) Translation :
- It involves moving an object from one position to another in 3D space.
- It shift's the object's coordinates along the x, y, z axis.

Q4) Expain the foll term :

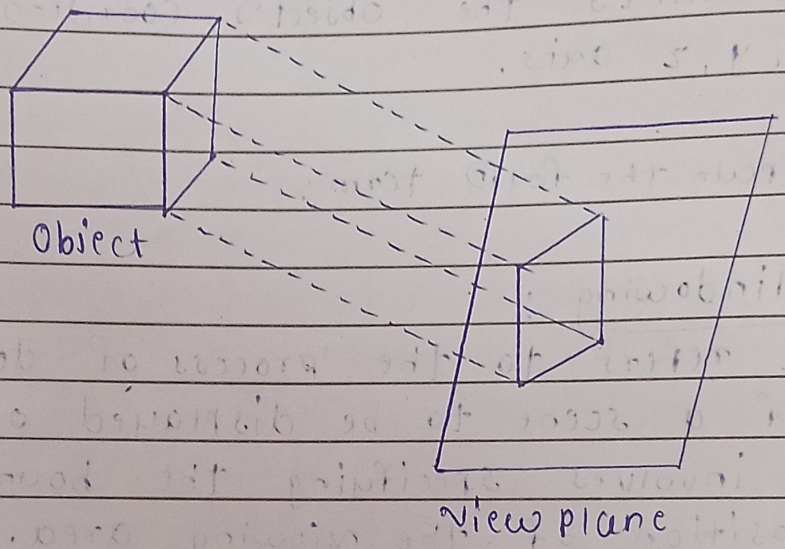
(i) Windowing :
- It refers to the process of defining a portion of a scene to be displayed on a screen.
- It involves specifying the boundaries and position of the viewing area.
- It involves defining a rectangular region in world coordinates that represents the portion of a scene to be displayed.

(ii) Clipping :
- is the process of removing portions of objects or geometry that fall outside the viewing area defined by the window.
- This ensures that only the visible parts of the objects are rendered on the screen.
- for instance, if an object extends beyond the boundaries of the window, clipping removes the parts that are outside the window to optimize rendering.

(iii) Viewport:
- is the final area on the screen where the rendered image is displayed after applying windowing & clipping.
- It represents the portion of the screen used to display the rendered scene.

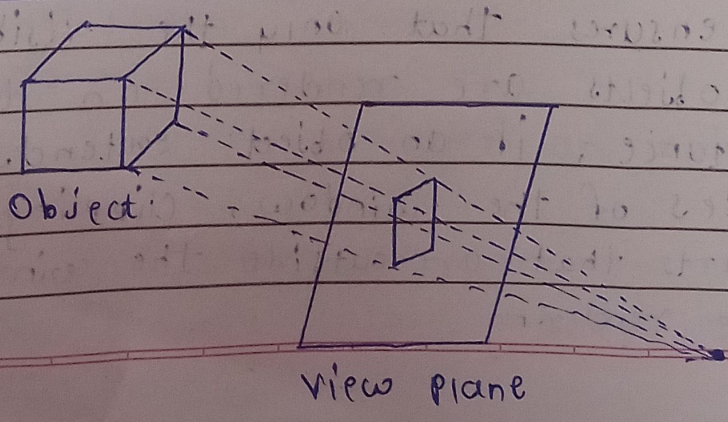
Q. 5) Explain parallel & perspective projection.

⟹ (i) parallel projection:



- is type of projection where all the projection lines are parallel.
- objects appear the same size regardless of their distance from the viewer.
- is used in technical drawings & architectural designs.

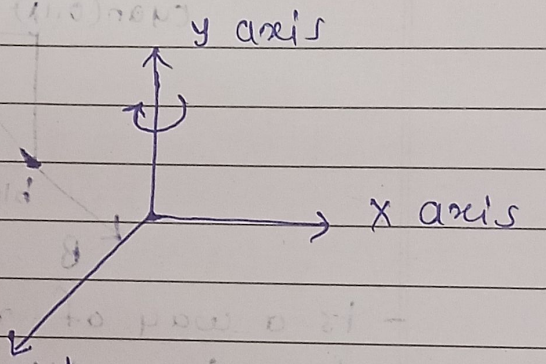
(ii) perspective projection:



- perspective projection are used by artist for drawing three-dimensional scenes.
- lines of projection do not remain parallel.
- line converge at a single point called a center of projection.
- characteristics of perspective are vanishing points & perspective foreshortening.
- cannot give accurate view of object.

Q.6) Explain 3D Transformation rotation about arbitrary axis.

⟶ - object is rotated about an axis that is not parallel to any of coordinate axis ; i.e. x, y, z.



① Translation :
- move the object so that the rotation axis passes through the origin.
- This involves translating the object and the rotation axis.

② Rotation : Rotate the object about the axis aligned with one of the coordinate axes.
- This can be done using standard rotation matrices.

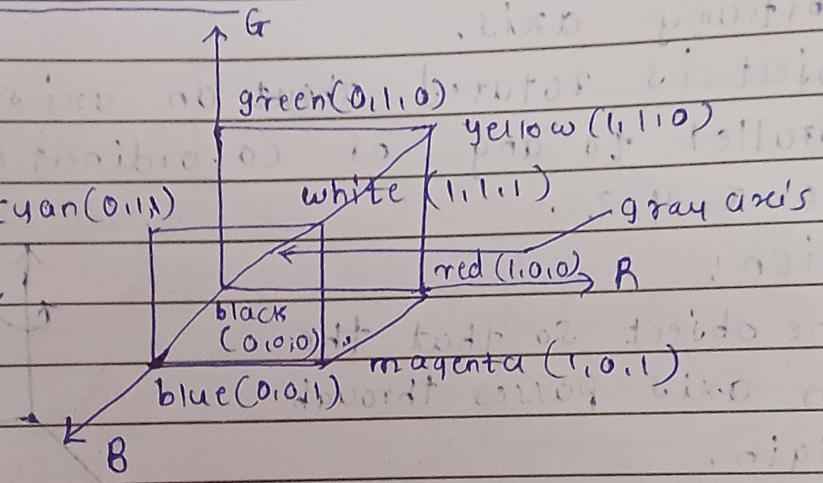
③ Inverse Translation :
- move the object back to its original position. This involves translating the object & the rotation axis back to their original position.

youtube
Cohen Sutherland line Clipping Algorithm.
Cohen Hodgeman polygon Clipping algorithm

Unit 4

Q (1) Explain in detail :

(i) RGB color model :



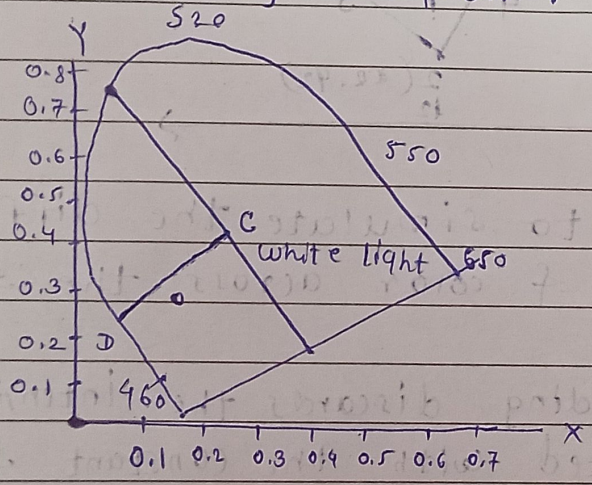
- Is a way of representing colors in terms of the intensities of red, green and blue light.
- Colors are created by combining different amounts of red, green & blue light.
- Each color component is tupically represented by an integer value ranging from 0 to 255.
- 0 indicates no intensity
- 255 indicates full intensity.
- Each primary color can take an intensity value ranging from 0 (lowest) to 1 (highest)
- mixing these three primary colors at different intensity levels produces a variety of colors.

(ii) HSV color model :

- Is the most accurate color model as long as the way humans perceive colors.
- humans perceive colors is just primary colors fused to create the spectrum.
- H stands for Hue, S stands for Saturation, V stands for Value.
- HSV model is wed in histogram equalization.
- converting grayscale images to RGB Color images.

(iii) CIE Chromaticity Diagram :-

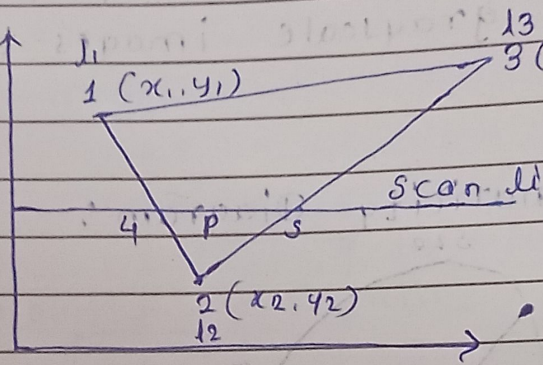
→



- is a graphical representation of the colors visible to the human eye, based on the work of the International Commission on Illumination.
- It maps all the colors visible to humans onto a two-dimensional plane.
- it represents the spectral colors and their mixtures based on the values of the primary colors (Red, green, Blue) contained by them.
- Chromaticity contains two parameters - hue & saturation.
- when we put hue and saturation together then it is known as chrominance.

Q.2) Define Shading:
Explain with help of diagrams ~~Gouraud~~ Gouraud shading algorithm in detail.

⟹ Shading:
- is the process of adding color to objects to make them appear three dimensional or to emphasize their shape.



- it is used to simulate the differing effect of light & color across the surface of an object.
- Gouraud shading discards the intensity discontinuities associated with the constant shading model
- it calculates lighting at the vertices of a 3D object, then interpolates these values across the object's surface to determine pixel colors.
- This creates a smooth shading effect, enhancing the realism of rendered images.
- Gouraud shading provides a simple & efficient way to simulate the appearance of light & shadow on 3D objects.
- It helps to create smooth transitions between different areas of a surface.

Q.3) What is Segment.? why do we need segments?

⟹ • segment :

- It refers to a portion of a line of or curve between two distinct endpoints.
- segments are fundamental in rendering & manipulating graphics, especially in vector graphics systems.
- They are crucial for representing shapes, paths & objects in a digital environments.

• different operations on segment :

① Transdation :
- moving a segment by a specified distance in the x & y directions.

② Rotation : Turning a segment around a specified point by a given angle.

③ Scaling : Enlarging or shrinking a segment by a specified factor along the x & y axes.

④ Reflection : flipping a segment across a specified axis or line.

⑤ Clipping : selectively displaying only the portion of a segment that lies within a specified region or window.

⑥ Intersection : finding the point(s) where two segments intersect, if they do.