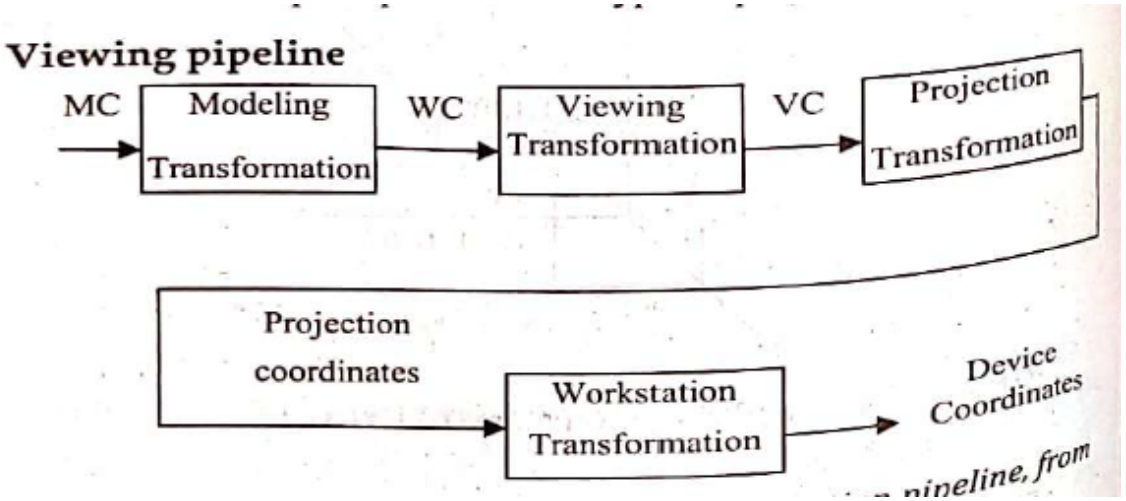
Chapter 4 (10 Marks)



The 3D viewing pipeline, as shown in the figure, is a sequence of transformations that convert the coordinates of objects from the 3D model space to 2D screen space for display. Let's go through each step of the pipeline in detail:

1. Modeling Transformation (MC to WC)

- **MC (Model Coordinates)**: The original coordinates of objects in the 3D model space.
- **WC (World Coordinates)**: The coordinates after the objects have been positioned and oriented in a 3D world.
- **Transformation**: This step involves applying a modeling transformation to place the model objects into the world coordinate system. It adjusts the model's position, orientation, and scale relative to the world.

2. Viewing Transformation (WC to VC)

- **WC (World Coordinates)**: The coordinate system that defines the position of all objects in the 3D world.
- **VC (Viewing Coordinates)**: The coordinate system defined by the position and orientation of the camera or viewer.

- **Transformation**: Viewing transformation changes the world coordinates to the viewing coordinates. It simulates the camera's position and orientation, aligning the coordinate system with the viewer's perspective.

3. Projection Transformation (VC to Projection Coordinates)

- **VC (Viewing Coordinates)**: The coordinate system aligned with the viewer or camera.
- **Projection Coordinates**: The coordinates after projection, representing how objects are mapped onto a 2D plane.
- **Transformation**: The projection transformation maps 3D coordinates into a 2D plane. This step can use either perspective projection, which simulates human eye perception, or orthographic projection, which does not account for depth and presents all dimensions equally.

4. Workstation Transformation (Projection Coordinates to Device Coordinates)

- **Projection Coordinates**: These represent the 3D objects in a 2D plane after projection.
- **Device Coordinates**: The final coordinates that map directly to the display device's pixel grid.
- **Transformation**: This step scales and translates the projection coordinates to the actual device coordinates, fitting the 2D image onto the display screen.

Summary of the Viewing Pipeline

The 3D viewing pipeline transforms 3D models from their original coordinates (model coordinates) to the screen coordinates (device coordinates) for display. Each transformation step (modeling, viewing, projection, and workstation) is essential for rendering the 3D objects correctly on a 2D screen, ensuring that their position, orientation, and perspective are accurately represented.