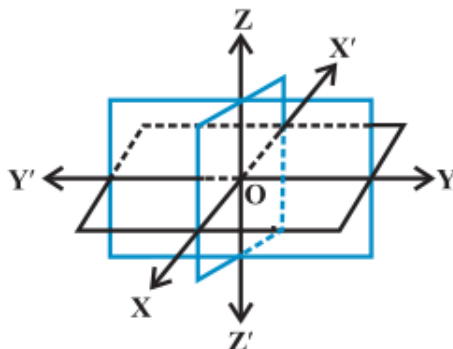


# Introduction to Three Dimensional Geometry

To refer to a point in space we require a third axis (say z-axis) which leads to the concept of three-dimensional geometry. In this chapter, we study the basic concept of geometry in three-dimensional space.

## Octant

Consider three mutually perpendicular planes meet at a point O.



Let these three planes intercept along three lines  $XOX'$ ,  $YOY'$  and  $ZOZ'$  called the x-axis, y-axis, and z-axis respectively. The three coordinate planes divide the space into eight parts known as octants. These octants could be named as  $XOYZ$ ,  $X'OYZ$ ,  $X'OY'Z$ ,  $XOY'Z$ ,  $XOYZ'$ ,  $X'OYZ'$ ,  $X'OY'Z'$  and  $XOY'Z'$ . and denoted by I, II, III, ..., VIII, respectively.

- coordinate of the point in x axis is of the form  $(x, 0, 0)$
- coordinate of the point in y axis is of the form  $(0, y, 0)$
- coordinate of the point in z axis is of the form  $(0, 0, z)$
- coordinate of the point in xy plane is of the form  $(x, y, 0)$
- coordinate of the point in yz plane is of the form  $(0, y, z)$
- coordinate of the point in xz plane is of the form  $(x, 0, z)$

The sign of the coordinates of a point determine the octant in which the point lies. The following table shows the signs of the coordinates in eight octants.

Octants Coordinates	I	II	III	IV	V	VI	VII	VIII
$x$	+	-	-	+	+	-	-	+
$y$	+	+	-	-	+	+	-	-
$z$	+	+	+	+	-	-	-	-

## Distance between Two Points

Distance between two points  $P(x_1, y_1)$  and  $Q(x_2, y_2)$  in 3D plane is

$$PQ = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$