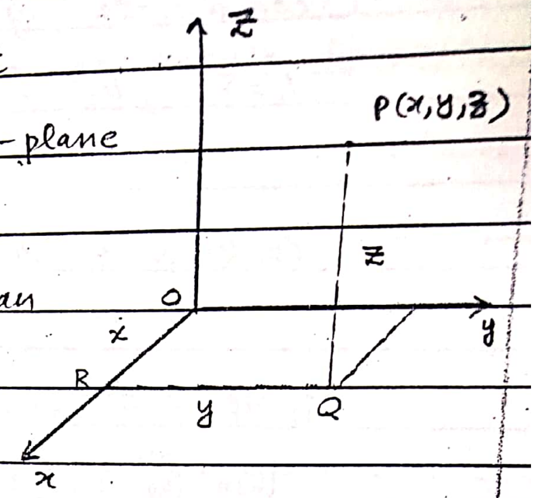
RECTANGULAR CARTESIAN COORDINATES:

let $P(x,y,z)$ be any point whose projection on the xy-plane is $Q(x,y)$.



Then the rectangular cartesian coordinates (x,y,z) of P are defined as

$x = OR$ $\quad y = RQ$ $\quad z = PQ$.

→ In rectangular cartesian coordinates system, the unit vectors are denoted by $\hat{i}, \hat{j}$ and $\hat{k}$.

→ In rectangular cartesian coordinate system vector $\vec{A}$ can be expressed in terms of unit vectors $\hat{i}, \hat{j}, \hat{k}$ as

$$\vec{A} = A_1\hat{i} + A_2\hat{j} + A_3\hat{k}$$

→ In rectangular cartesian coordinate system position vector $\vec{r}$ is given by

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

→ Scalar factors are

$$h_1 = \left|\frac{\partial \vec{r}}{\partial x}\right| = |\hat{i}| = 1$$

$$h_2 = \left|\frac{\partial \vec{r}}{\partial y}\right| = |\hat{j}| = 1$$

$$h_3 = \left|\frac{\partial \vec{r}}{\partial z}\right| = \hat{k} = 1$$

→ The rectangular cartesian coordinate system is a particular case of an orthogonal curvilinear coordinate system where

$u_1 = x$, $u_2 = y$, $u_3 = z$ and $h_1 = 1$, $h_2 = 1$, $h_3 = 1$

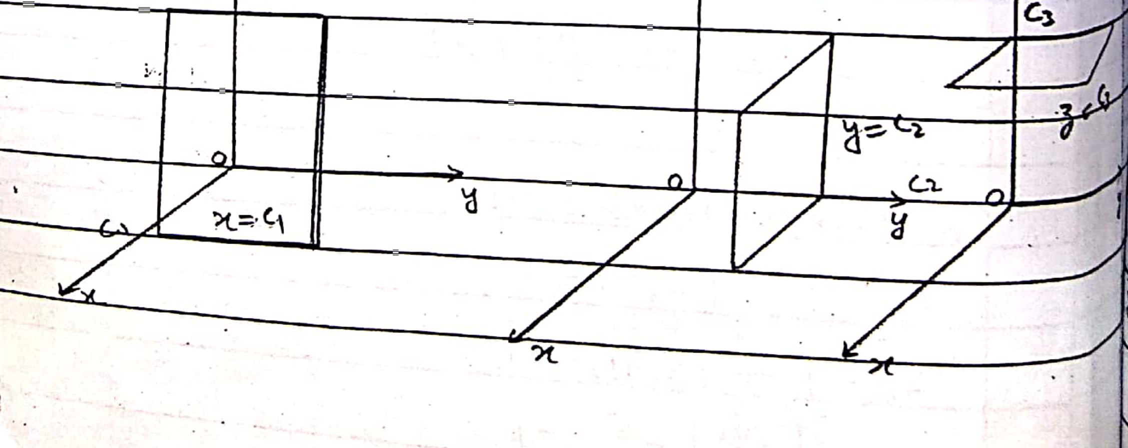
COORDINATE SURFACES:

i) If x is held constant while y and z vary Then the equation $x = c_1$ represents a "plane" parallel to yz-plane.

ii) If y is held constant while x and z vary Then the equation $y = c_2$ represents a "plane" parallel to xz-plane.

iii) If z is held constant while x and y vary then the equation $z = c_3$ represents a "plane" parallel to xy-plane.

→ Coordinate surfaces are mutually orthogonal in the sense that any two of them intersect at right angle



→ Each point in the rectangular coordinate system is the intersection of the three coordinate surfaces $x = c_1$, $y = c_2$, $z = c_3$.

COORDINATE CURVES:

i) If y and z are fixed while x varies then the intersection of $y = c_2$ and $z = c_3$ is a straight line parallel to the x-axis is called the x-coordinate curve (line).

ii) If x and z are fixed while y varies then the intersection of $x = c_1$ and $z = c_3$ is a straight line parallel to the y-axis is called the y-coordinate curve (line).

iii) If x and y are fixed while z varies then the intersection of $x = c_1$ and $y = c_2$ is a straight line parallel to the z-axis is called the z-coordinate curve (line).

→ Coordinate curves of the rectangular cartesian coordinate system are the straight lines passing through the point P.