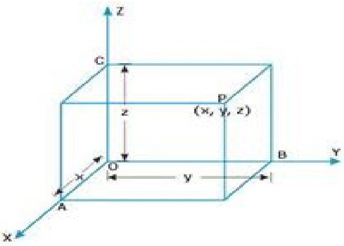
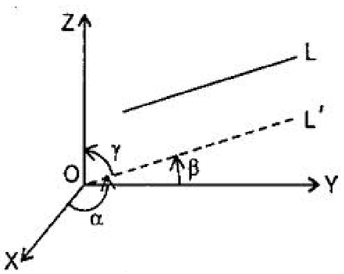
Direction Cosines and Direction Ratios of a Line

Created: Thursday, 15 September 2011 05:41 | Published: Thursday, 15 September 2011 05:41 | Written by Super User | Print

Introduction



We have already learned the basic concepts of vectors. In this topic we will use the concepts of vector algebra to the three dimensional geometry. In thethree dimensional geometry, we deal with direction cosines, direction ratios, equations of line in space, equation of plane in space etc.



Direction Cosines

If a directed line L' passing through the origin makes angles ?, ? and ? with x, y and z axes respectively then cosine of these angles namely,

cos?, cos? and cos? are called direction cosines of the directed line L'.

Usually the direction cosines are denoted by l, m and n

l=cos?, m=cos? and n=cos?

Relation between the direction cosines of a line

If l, m and n are the direction cosines of a line then $l^2+m^2+n^2=1$

Also, $\cos^2$?+$\cos^2$?+$\cos^2$?=1

Direction cosines of a line passing through two points

Let P(x_1, y_1, z_1) and Q(x_2, y_2, z_2) be two points on a line L, then

PQ = ?((x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2)

Direction cosines of the line L is given by, $\frac{x_2-x_1}{PQ}, \frac{y_2-y_1}{PQ}, \frac{z_2-z_1}{PQ}$

Direction Ratios of a line

Any three numbers which are proportional to the direction cosines of a line are called direction ratios of the line. If l, m and n are direction cosines abd a, b and c are direction ratios of a line then a=?l, b=?m and c=?n.

It can also be written as $\frac{l}{a} = \frac{m}{b} = \frac{n}{c} = \lambda$

If P(x_1, y_1, z_1) and Q(x_2, y_2, z_2) are any two points the direction ratios of PQ is given by <x_2-x_1, y_2-y_1, z_2-z_1>

Direction cosines of x, y and z-axis

X-axis makes angles 0?, 90? and 90? with itself, so the direction cosines are cos0?, cos90? and cos90? = <1, 0, 0>

Y-axis makes angles 90?, 0? and 90? with itself, so the direction cosines are cos90?, cos0? and cos90? = <0, 1, 0>

Z-axis makes angles 90?, 90? and 0? with itself, so the direction cosines are cos90?, cos90? and cos0? = <0, 0, 1>

Condition for collinearity

If a_1, b_1, c_1 and a_2, b_2, c_2 are the direction cosines of line joining two points then the points are said to be collinear

if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Example: Find the direction cosines of a line which makes equal angles with the coordinate axes.

Solution: Given ? = ? = ?, so cos? = cos? = cos?

l=m=n

$l^2+m^2+n^2=1$

$l^2+l^2+l^2=1$

$3l^2=1$

l^2=1/3

l=±1/?3

l=m=n=±1/?3

Hence direction cosines are <±1/?3, ±1/?3, ±1/?3>

Now try it yourself! Should you still need any help,click here to schedule live online session with e Tutor!

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Reference Links:-

- http://en.wikipedia.org/wiki/Direction_cosine
- http://www.solitaryroad.com/c400.html
- http://en.wikipedia.org/wiki/Three-dimensional_space

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