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Plane

SUBJECT : MATHEMATICS
CHAPTER NUMBER:11
CHAPTER NAME :THREE DIMENTIONAL GEOMETRY

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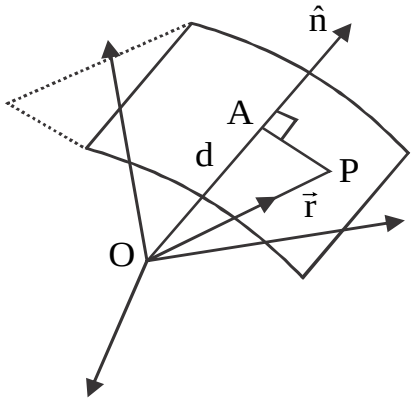
Introduction

Definition:- A plane is a surface such that if any two distinct points A and B are taken on it, then the line segment AB lies on the surface.

Equation of Plane in Different forms

Normal Form

The **vector equation** of a plane which is at a distance d from the origin, and $\hat{n}$ is the unit vector normal to the plane through the origin is $\vec{r}.\hat{n} = d$.



In this figure OA is the normal drawn from O on the plane $\hat{n}$ is the unit vector along $\overrightarrow{OA} = d\hat{n}$, $\vec{r}$ =P.V of P.

Equation of Plane in Different forms

Normal Form

The **Cartesian equation** of the plane in normal form which is at a distance of d from the origin and l, m, n as dcs of normal drawn from the origin is $lx + my + nz = d$.

As l, m, n is the dcs of normal to plane drawn from origin

thus $\hat{n} = l\hat{\imath} + m\hat{\jmath} + n\hat{k}$

Equation of Plane in Different forms

Conclusion:

- The co-ordinate of the foot of perpendicular drawn from the origin to the plane is (ld, md, nd)

- If $\vec{r}.\left(a\hat{\imath} + b\hat{\jmath} + c\hat{k}\right) = d$ is the vector equation of a plane, then $ax + by + cz = d$ is the cartesian equation of the plane where a, b, c are drs of the normal to plane and $a\hat{\imath} + b\hat{\jmath} + c\hat{k} = \vec{N}$ (say) vector normal to the plane.

Example

Find the vector equation of a plane that is at a distance of 5 units from the origin which is normal to vector $2\hat{\imath} - 3\hat{\jmath} + 6\hat{k}$.

Example

Find the vector normal to the plane $2x + y - 3z = 1$.

Example

If the vector equation of a plane is $\vec{r}.\left(4\hat{\imath}+\hat{\jmath}-\hat{k}\right)=-2$, then reduce it to cartesian form.

Example

If the equation of a plane is $-2x + 6y - 3z = -7$, then find the

(i) Length of perpendicular drawn from origin to the plane.

(ii) Direction cosines of the vector normal to the plane.

(iii) Coordinates of the foot of perpendicular drawn from the origin to the plane.

(iv) Equation of the plane in normal form.

Assignments

1. Find the vector equation of a plane that is at a distance of 18 units from the origin which is normal to vector $2\hat{\imath} + 3\hat{\jmath} + 6\hat{k}$.
2. Find the length of the perpendicular from origin to plane $x - 2y - 2z = 15$. Also, find dcs of the normal to the plane and coordinate of the foot of perpendicular.
3. Question no 1 to 4 from Exercise 11.3 from NCERT book.

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