The Plane

(1) $The\ general\ equation\ of\ a\ plane\ is\ ax + by + cz + d = 0.\ The\ d.r.'s\ of\ the\ normal\ to\ the\ plane\ are\ a, b, c.$

(2) $The\ equation\ of\ the\ plane\ passing\ through\ the\ point\ P(x_1, y_1, z_1)\ is$

$a(x - x_1) + b(y - y_1) + c(z - z_1) = 0.$

(3) $If\ a\ plane\ makes\ intercepts\ a, b\ and\ c\ with\ the\ X - axis, Y - axis\ and\ Z - axis\ respectively, then\ its\ equation\ is\ \frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1.$

(4) $The\ equation\ of\ a\ plane\ passing\ through\ three\ points\ A(x_1, y_1, z_1), B(x_2, y_2, z_2)\ and\ C(x_3, y_3, z_3)\ is\ given\ by$

$$\begin{vmatrix} x - x_1 & y - y_1 & z - z_1 \\ x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ x_3 - x_1 & y_3 - y_1 & z_3 - z_1 \end{vmatrix} = 0$$

(5) (i) $Let\ a\ plane\ be\ at\ a\ distance\ p\ from\ the\ origin\ and\ let\ \hat{n}\ be\ a\ unit\ vector\ perpendicular\ to\ the\ plane.$

$Then, equation\ of\ the\ plane\ is\ \vec{r}.\hat{n} = p.$

(ii) $The\ cartesian\ form\ of\ equation\ of\ this\ plane\ is\ lx + my + nz = p, where\ l, m, n\ are\ the\ d.c.'s\ of\ normal\ to\ the\ plane.$

(iii) $If\ \vec{n}\ is\ a\ vector\ normal\ to\ a\ given\ plane\ then\ \vec{r}.\hat{n} = q\ represents\ a\ plane.$

(iv) $The\ cartesian\ form\ is\ ax + by + cz + d = 0, where\ a, b, c\ are\ the\ d.r.'s\ of\ \vec{n}.$

(6) (i) $The\ vector\ equation\ of\ a\ plane\ passing\ through\ a\ point\ A\ with\ p.v.\ \vec{a}\ and\ perpendicular\ to\ \vec{n}\ is\ (\vec{r} - \vec{a}).\vec{n} = 0.$

(ii) $The\ cartesian\ equation\ of\ a\ plane\ passing\ through\ a\ point\ A(x_1, y_1, z_1)\ and\ perpendicular\ to\ a\ line\ having\ d.r.'s\ a, b, c\ is$

$$a(x - x_1) + b(y - y_1) + c(z - z_1) = 0.$$

(7) **Distance of a Plane from a point**

Vector Form

(i) $Let\ p\ be\ the\ length\ of\ perpendicular\ drawn\ from\ a\ point\ P\ with\ p.v.\ \vec{a}\ to\ the\ plane\ \vec{r}.\vec{n} = q. Then,$

$$p = \frac{|\vec{a}.\vec{n} - q|}{|\vec{n}|}.$$

(ii) $Let\ p\ be\ the\ length\ of\ perpendicular\ drawn\ from\ the\ origin\ to\ the\ plane\ \vec{r}.\vec{n} = q. Then,$

$p = \frac{|q|}{|\vec{n}|}.$