1 Equation of Tangent

To find tangent equation to the circle from a point $P(x_1, y_1)$ on it, use general form of circle. Since point P is on circle,

$$x_1^2 + y_1^2 + 2gx_1 + 2fy_1 + c = 0$$

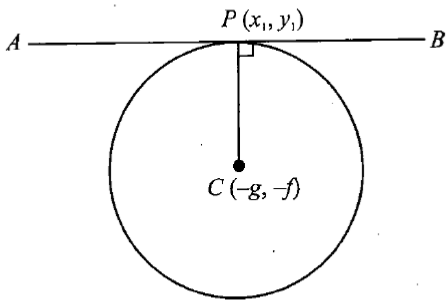

Figure 1: Tangent on Circle

Slope of line CP can be given as,

$$\textbf{slope of CP} = \frac{y_1 + f}{x_1 + g}$$

As tangent AB is perpendicular to CP,

$$\textbf{slope of tangent AB} = -\frac{x_1 + g}{y_1 + f}$$

Now we have slope of line AB and it passes through point P, equation of tangent is,

$$y - y_1 = -\frac{x_1 + g}{y_1 + f}(x - x_1)$$

2 Length of Tangent from a given point

Consider general form of circle $x^2 + y^2 + 2gx + 2fy + c = 0$ with center $(-g, -f)$ and radius $\sqrt{g^2 + f^2 - c}$. Point is $P(x_1, y_1)$. Look at the diagram,

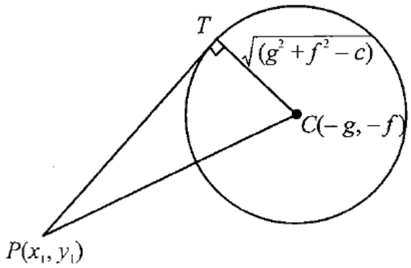

Figure 2: Length of tangent

Length of PC,

$$PT = \sqrt{(PC)^2 - (CP)^2}$$

Put value of PC and CP, we get after solving

$$PT = \sqrt{x_1^2 + y_1^2 + 2gx_1 + 2fy_1 + c}$$

Put point value in general form of circle, and take its sq. root to get length of tangent from a point.

3 Equation of Normal

Note that any normal on circle is a straight line which is perpendicular to the tangent that passes through center of the circle and point of contact on circle. Visualization of the same,

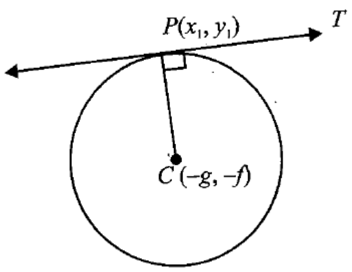

Figure 3: Normal on Circle

Slope of CP,

$$\textbf{slope of CP} = \frac{y_1 + f}{x_1 + g}$$

Now we have slope of line CP and it passes through point P, equation of normal is,

$$y - y_1 = \frac{y_1 + f}{x_1 + g}(x - x_1)$$