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Indian Institute of Technology Hyderabad

ELECTRICAL ENGINEERING
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Assignment-6

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Problem Statement:

Find the equations of tangent and normal to the parabola $y^2 = 4ax$ at point (at^2,2at) .

SOLUTION:

Given:

The given equation of parabola $y^2 = 4ax$ can be written as

$$\mathbf{x}^\top \mathbf{V}\mathbf{x} + 2\mathbf{u}^\top \mathbf{x} + f = 0 \tag{1}$$

where

$$\mathbf{V} = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}, \tag{2}$$

$$\mathbf{u} = \begin{pmatrix} -2a \\ 0 \end{pmatrix}, \tag{3}$$

$$f = 0 \tag{4}$$

To Find

Equation of tangent and normal at point (at^2,2at)

STEP-1

The equation of tangent is given by

$$(\mathbf{V}\mathbf{q} + \mathbf{u})^\top \mathbf{x} + \mathbf{u}^\top \mathbf{q} + f = 0 \tag{5}$$

where

$$\mathbf{q} = \begin{pmatrix} at^2 \\ 2at \end{pmatrix} \tag{6}$$

substituting $\mathbf{V}$, $\mathbf{u}$, $\mathbf{q}$ and f in (5) we get the tangent equation as

$$\begin{pmatrix} -(1/t) & 1 \end{pmatrix} \mathbf{x} = at \tag{7}$$

STEP-2

The equation of normal is given by

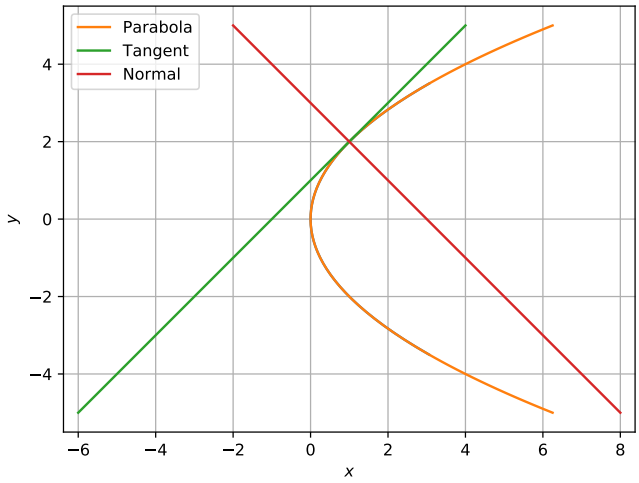
$$\mathbf{m}^\top (\mathbf{x} - \mathbf{q}) = 0 \tag{8}$$

where $\mathbf{m}$ is given by:

$$\mathbf{m} = \begin{pmatrix} 1 \\ 1/t \end{pmatrix} \tag{9}$$

substituting $\mathbf{m}$,$\mathbf{q}$ in (8) we get the normal equation as

$$\begin{pmatrix} t & 1 \end{pmatrix} \mathbf{x} = 2at + at^3 \tag{10}$$



Construction

vertex	coordinates
$\mathbf{q}$	$\begin{pmatrix} at^2 \\ 2at \end{pmatrix}$

Download the code
Github link: Assignment-6.