

## Chapter 10 Vector Calculus

$$(2) |\hat{b}| = 1 \Rightarrow \hat{b} \cdot \frac{d\hat{b}}{ds} = 0 \Rightarrow \hat{b} \perp \frac{d\hat{b}}{ds}$$

$$\text{for } \hat{b} \cdot \hat{t} = 0 \Rightarrow 0 = \frac{d}{ds}(\hat{b} \cdot \hat{t}) = \frac{d\hat{b}}{ds} \cdot \hat{t} + \hat{b} \cdot \frac{d\hat{t}}{ds} = \frac{d\hat{b}}{ds} \cdot \hat{t} + \hat{b} \cdot \kappa \hat{t} = \frac{d\hat{b}}{ds} \cdot \hat{t} \Rightarrow \hat{t} \perp \frac{d\hat{b}}{ds}$$

$$\frac{d\hat{b}}{ds} \text{ perpendicular to } \hat{b} \text{ and } \hat{t} \Rightarrow \frac{d\hat{b}}{ds} \propto \hat{n}$$

$$\frac{d\hat{b}}{ds} = -\tau \hat{n} \Rightarrow \tau = -\hat{n} \cdot \frac{d\hat{b}}{ds} \text{ the torsion of a curve}$$

$$\sigma = \frac{1}{\tau} \text{ the radius of the torsion}$$

$$(3) \hat{n} = \hat{b} \times \hat{t}$$

$$\frac{d\hat{n}}{ds} = \frac{d\hat{b}}{ds} \times \hat{t} + \hat{b} \times \frac{d\hat{t}}{ds} = -\tau \hat{n} \times \hat{t} + \hat{b} \times \kappa \hat{t} = \tau \hat{b} - \kappa \hat{t}$$

**Frenet-Serret**

**formula:**

$$\frac{d\hat{t}}{ds} = \kappa \hat{n}$$

$$\frac{d\hat{n}}{ds} = \tau \hat{b} - \kappa \hat{t}$$

$$\frac{d\hat{b}}{ds} = -\tau \hat{n}$$

# Calculus And Vectors 1

**William G. Raymond**



## Calculus And Vectors 1:

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