Thm Differentiation Rules for Vector Functions

Let $\vec{u}(t)$ & $\vec{v}(t)$ be differentiable, $\vec{C}$ constant vector, c any scalar, & $f(t)$ any differentiable function.

1) Constant Function Rule: $\frac{d}{dt}\vec{C} = 0$

2) Scalar multiple Rules: $\frac{d}{dt}[c\,\vec{u}(t)] = c\,\vec{u}\,'(t)$

$\frac{d}{dt}[f(t)\,\vec{u}(t)] = f'(t)\,\vec{u}(t) + f(t)\,\vec{u}\,'(t)$

3) Sum Rule: $\frac{d}{dt}[\vec{u}(t) + \vec{v}(t)] = \vec{u}\,'(t) + \vec{v}\,'(t)$

4) Difference Rule: $\frac{d}{dt}[\vec{u}(t) - \vec{v}(t)] = \vec{u}\,'(t) - \vec{v}\,'(t)$

5) Dot Product Rule: $\frac{d}{dt}[\vec{u}(t) \cdot \vec{v}(t)] = \vec{u}\,'(t) \cdot \vec{v}(t) + \vec{u}(t)\,\vec{v}\,'(t)$

6) Cross Product Rule: $\frac{d}{dt}[\vec{u}(t) \times \vec{v}(t)] = \vec{u}\,'(t) \times \vec{v}(t) + \vec{u}(t) \times \vec{v}\,'(t)$

7) Chain Rule: $\frac{d}{dt}[\vec{u}(f(t))] = f'(t)\,\vec{u}\,'(f(t))$