Lecture VII Notes

Michael Brodskiy

Professor: V. Cherkassky

June 24, 2020

0.1 Formulas From 13.3

1. $\overrightarrow{T}(t) = \frac{\overrightarrow{r}'(t)}{|\overrightarrow{r}'(t)|}$
2. $\overrightarrow{N}(t) = \frac{\overrightarrow{T}'(t)}{|\overrightarrow{T}'(t)|}$
3. $\overrightarrow{B}(t) = \overrightarrow{T}(t)$ x $\overrightarrow{N}(t)$
4. $\kappa(t) = \frac{|\overrightarrow{T}'(t)|}{|\overrightarrow{r}'(t)|} = \frac{|\overrightarrow{r}'(t) \text{ x } \overrightarrow{r}''(t)|}{|\overrightarrow{r}'(t)|^3}$

1 Formulas of Frenet-Serret

1. $\frac{d\overrightarrow{T}}{ds} = \kappa\overrightarrow{N}$
2. $\frac{d\overrightarrow{N}}{ds} = -\kappa\overrightarrow{T} + \tau\overrightarrow{B}$
3. $\frac{d\overrightarrow{B}}{ds} = -\tau\overrightarrow{N}$

2 Motion in Space − 13.4

1. $\overrightarrow{v}(t) = \overrightarrow{r}'(t)$
2. $\overrightarrow{a}(t) = \overrightarrow{v}'(t) = \overrightarrow{r}''(t)$
3. speed $= |\overrightarrow{v}(t)|$
4. The force, $\overrightarrow{F}$ is always acting in the same direction as the acceleration, $\overrightarrow{a}$, with proportionality constant mass, m
5. In a circular path, an object's position is given by: $\overrightarrow{r}(t) = a\cos\omega t\hat{\mathbf{i}} + a\sin\omega t\hat{\mathbf{j}}$, where a is the radius of the circle, and ω is the constant speed of the object. The velocity is given by: $\overrightarrow{r}'(t) = \overrightarrow{v}(t) = -a\omega\sin\omega t\hat{\mathbf{i}} + a\omega\cos\omega t\hat{\mathbf{j}}$, and the acceleration is given by: $\overrightarrow{a}(t) = \overrightarrow{v}'(t) = -a\omega^2\cos\omega t\hat{\mathbf{i}} - a\omega^2\sin\omega t\hat{\mathbf{j}}$
6. Also in circular motion, $\overrightarrow{F}(t) = m\overrightarrow{a}(t) = -m\omega^2(a\cos\omega t\hat{\mathbf{i}} + a\sin\omega t\hat{\mathbf{j}})$