Physics Lecture

Philip Policki

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Contents

1 Introduction

1.1 How to pass

There will be a remote exam, more info nearing the end of the semester.

1.2 Curriculum

1. Kinematics
2. Dynamics
3. Quantum

2 Some math

$f'(t) = \frac{df(t)}{dt} = \lim_{\Delta t \to 0} \frac{f(t+\Delta t) - f(t)}{\Delta t}$
Velocity is a derivative of the position vector.
Acceleration is a derivative of the velocity vector as well as the second derivative of the position vector.

3 Vector Operations

1. Dot product / Scalar product
   $A \cdot B = |A||B|cos(\alpha)$
   $A \cdot B = a_x * b_x + a_y * b_y + a_z * b_z$
   $A \cdot A = |A||B|cos(0) = |A|^2$
2. Vector Scaling
   $kA = (kx_a, ky_a, kz_a)$

4 Kinematics

4.1 Cartesian reference frame

$f'(x) = \frac{df(x)}{dx} = \lim_{\Delta t \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$

- Position Vector $\vec{r}(x^{(t)}, y^{(t)}, z^{(t)})$
- Velocity Vector $\vec{v} = \frac{d\vec{r}}{dt}$
  $|\vec{v}| = \sqrt{\dot{x}^2 + \dot{y}^2 + \dot{z}^2}$

- Acceleration Vector $\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}(\frac{d\vec{r}}{dt}) = \frac{d^2}{dt_2} = \ddot{\vec{r}} = \dot{\vec{v}}$
  $|\vec{a} = \sqrt{\ddot{x}^2 + \ddot{y}^2 + \ddot{z}^2}|$

4.1.1 circular motion

$\vec{r} = x\hat{n_x} + y\hat{n_y}$
$\vec{v} = \dot{x}\hat{n_x} + \dot{x}\hat{n_Y}$

4.2 Cylindrical reference frame

Helps to simplify motions like circular, spiral in 2d or 3d etc. Coordinates in the rf:

- z = height
- ρ magnitude of the radius
- ϕ projection angle of the radius