F111. Mechanics, Oscillations and Waves. Sem 1 2024-25

Part 1

Mechanics lecture series 2
Prof. A V Kulkarni

2 August 2024

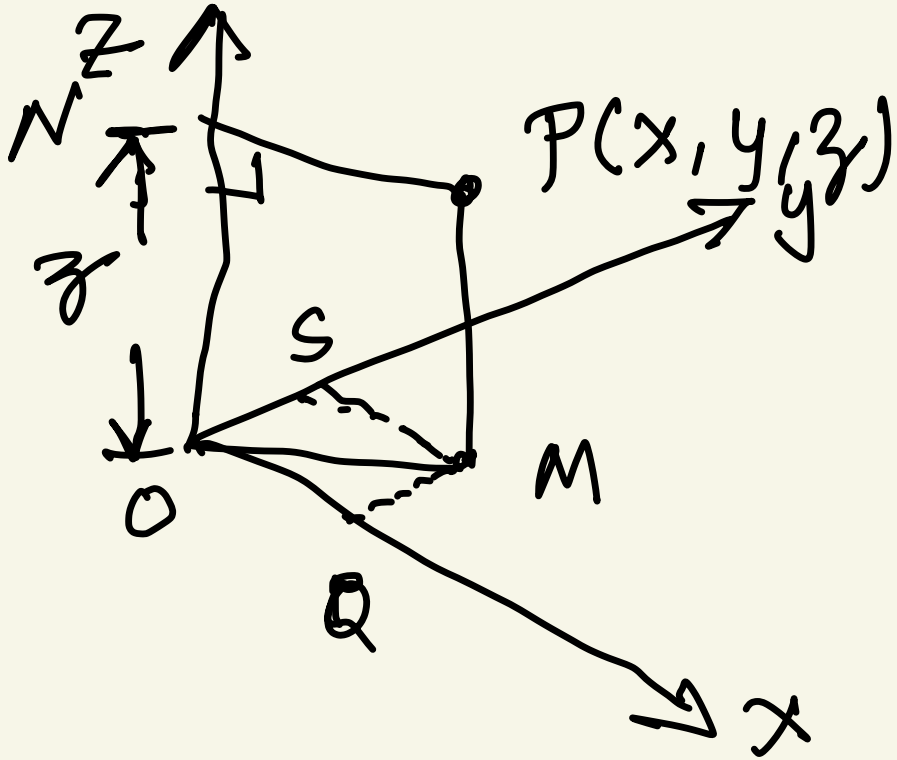
Mechanics ← Study of motion

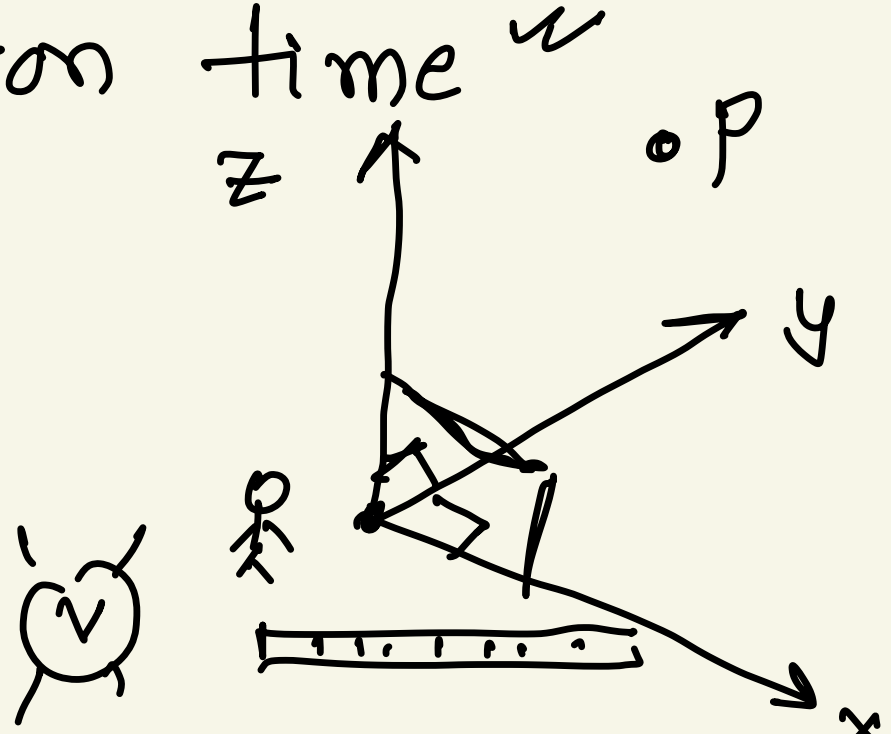
- Kinematics
  - describes motion
- Statics
  - Counter to causes of motion
- Dynamics
  - Causes of motions

Kinematics

position → time

Co-ordinate system





Cartesian

$ON = z$

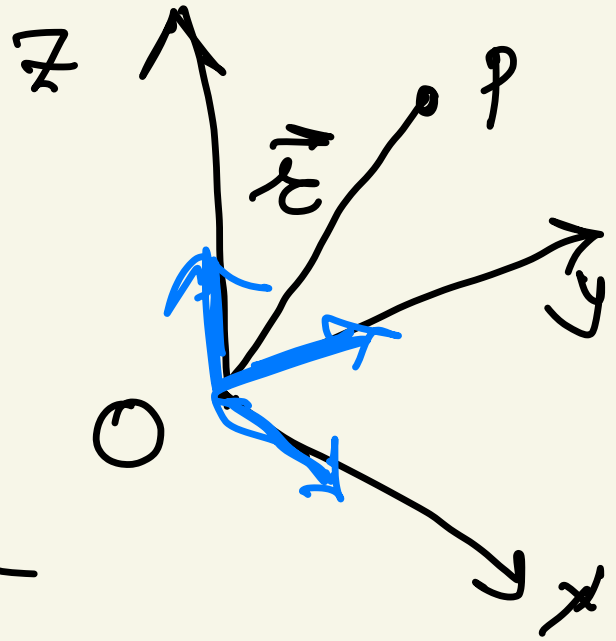
$OQ = x$

$OS = y$

Co-ordinates

Vector → magnitude + direction

scalar – magnitude



$\overrightarrow{OP} = \vec{r}$ = position vector of P

$|\vec{r}|$ = magnitude of $\vec{r}$ = length of segment OP

blue vectors have unit length } unit vectors

point away from the origin

point along the co-ordinate axis

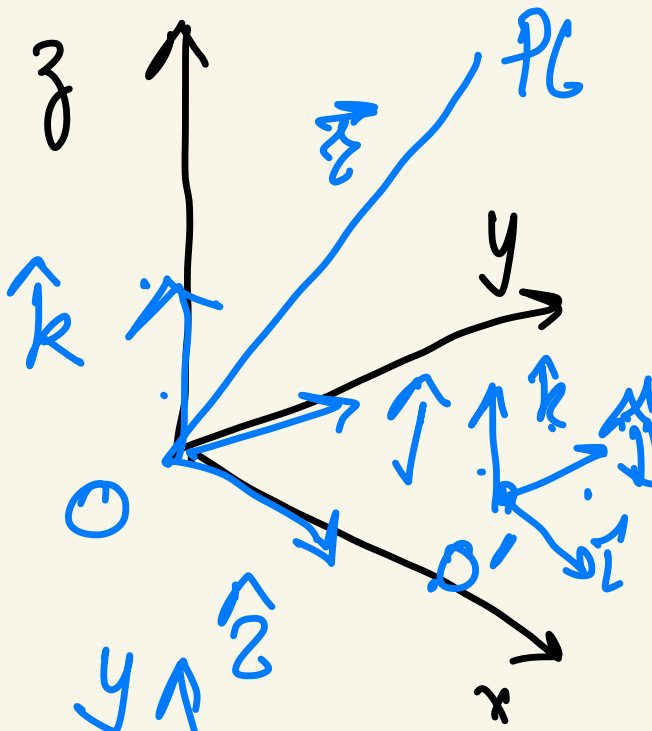
$P(x, y, z)$

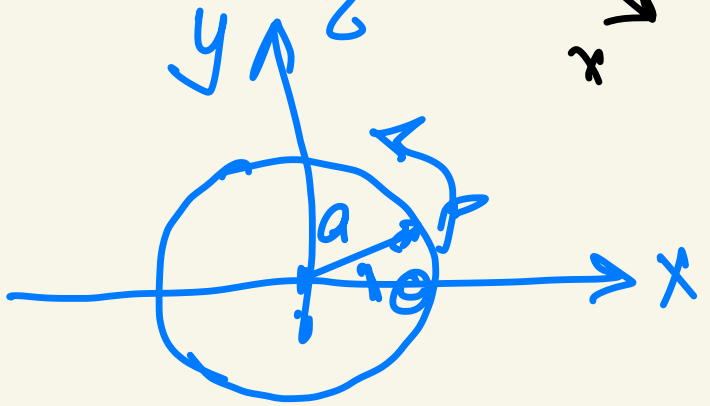
$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$

$\vec{r} = \vec{r}(t)$ $\quad x = x(t)$

$y = y(t)$

$z = z(t)$

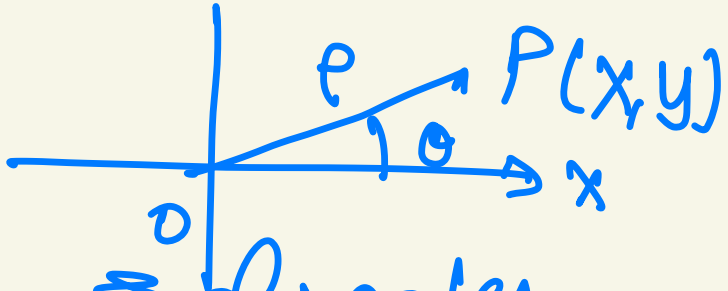




$x = a\cos\theta$

$y = a\sin\theta$; $\theta = \theta(t) = \omega t$; $\omega = \text{rads/sec}$

$x^2 + y^2 = a^2$



$P(\rho, \theta) \rightarrow$ Polar Co-ordinates

$x = \rho\cos\theta$

$y = \rho\sin\theta$