

# Lecture 1

## APL104

### Solid Mechanics

Instructors: Prof. Ajeet Kumar, Prof. Rajdip Nayek

TAs:

Course website:

Reference book

→ Advanced Mechanics of Solids  
(L.S. Srinath)

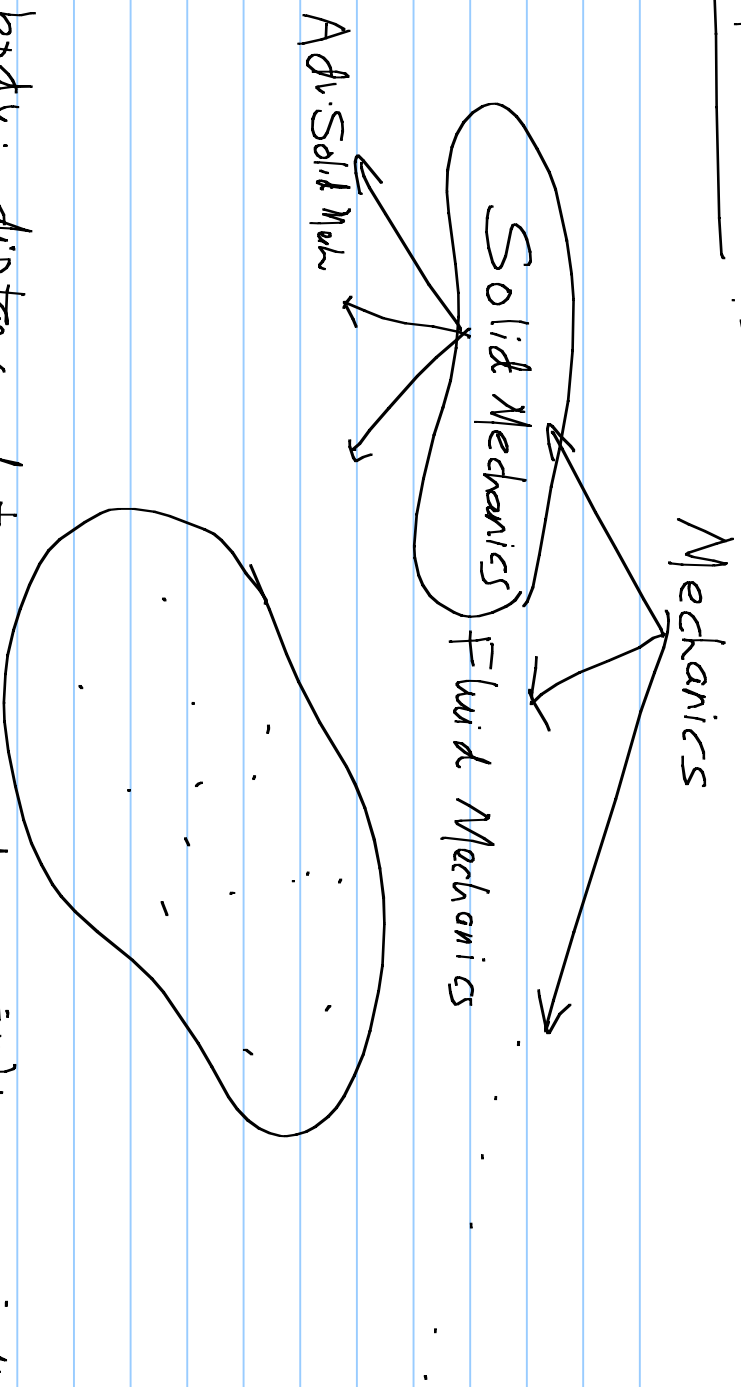
→ Strength of Materials (Timoshenko)

↓  
Father of Solid Mech.

Minsr - 30%  
Majsr - 40%  
≥ quizzed; 10x2  
Attendance: 10%. ( $> 80\%$ )

→ If it is not more than 80%, you  
will fail

# Solid Mechanics :

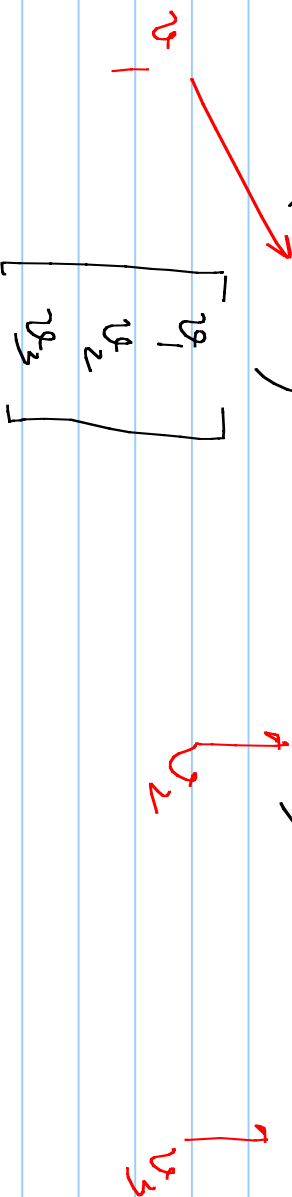


Rigid body: distance between any two points remain the same!

## Mathematical Preliminaries

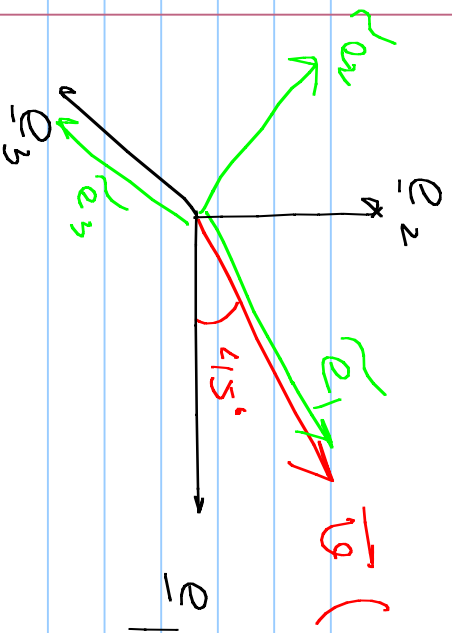
Vectors: A vector has magnitude and direction

$$\vec{r} = (\vec{r} \cdot \hat{e}_1) \hat{e}_1 + (\vec{r} \cdot \hat{e}_2) \hat{e}_2 + (\vec{r} \cdot \hat{e}_3) \hat{e}_3$$



The diagram illustrates the decomposition of a vector  $\vec{r}$  into its components. A red vector labeled  $\vec{r}$  originates from the origin. A red arrow points from  $\vec{r}$  to the first component  $v_1$  in the column vector. Another red arrow points from  $\vec{r}$  to the second component  $v_2$  in the column vector. A third red arrow points from  $\vec{r}$  to the third component  $v_3$  in the column vector. The column vector is written as  $\begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$ . The unit vectors  $\hat{e}_1$ ,  $\hat{e}_2$ , and  $\hat{e}_3$  are indicated by red arrows pointing to the respective components  $v_1$ ,  $v_2$ , and  $v_3$ .

→ A vector is independent of the coordinate system whereas its components (its column form) are dependent on the coordinate system.



$\vec{u}$  (unit vector)  
lying in  $\bar{e}_1$ - $\bar{e}_2$  plane

$$\begin{bmatrix} \vec{u} \end{bmatrix} = \begin{bmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \\ 0 \end{bmatrix}$$

$(\bar{e}_1 - \bar{e}_2 - \bar{e}_3)$

$$\begin{bmatrix} \vec{u} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

$(\tilde{e}_1 - \tilde{e}_2 - \tilde{e}_3)$