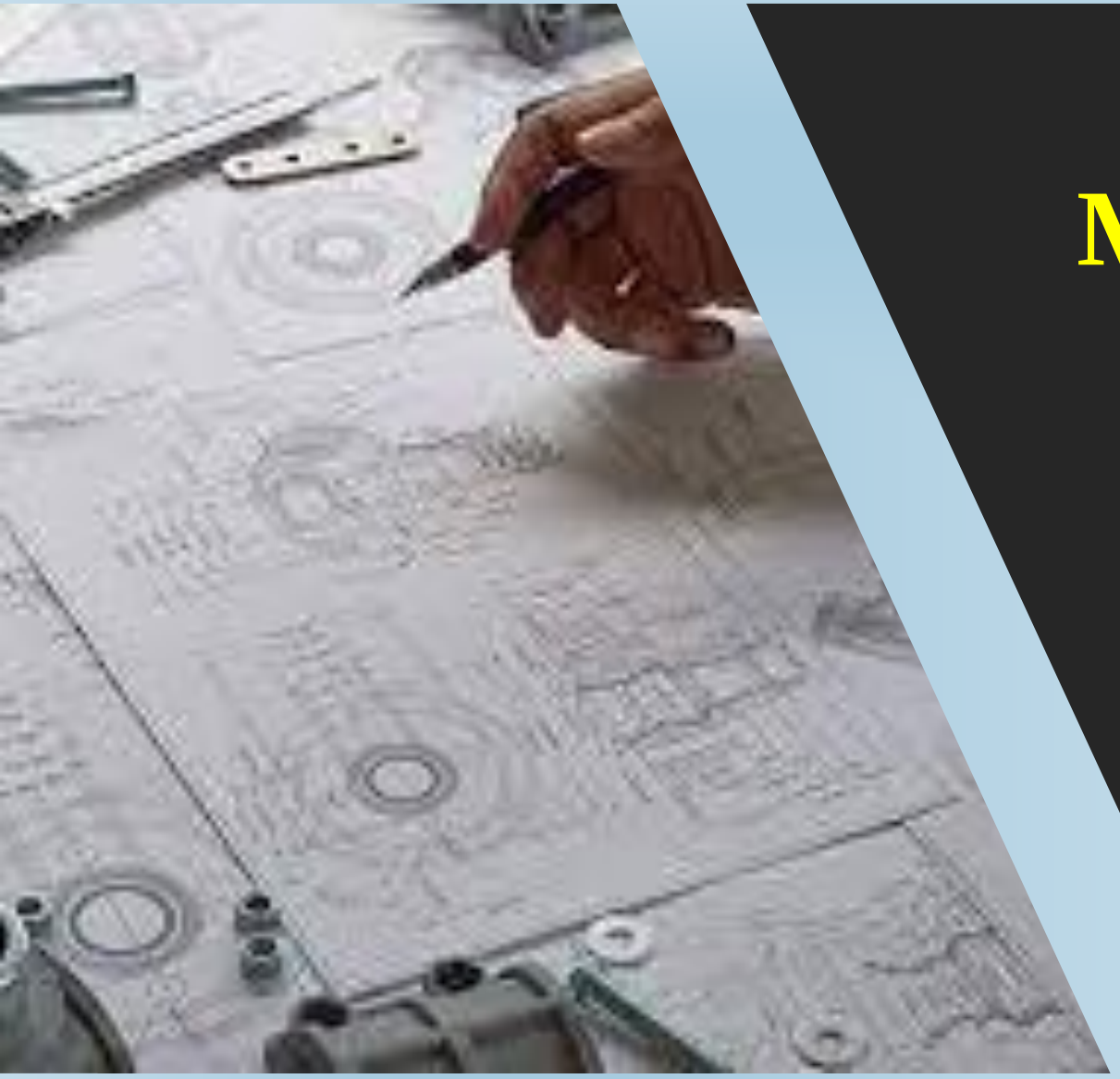


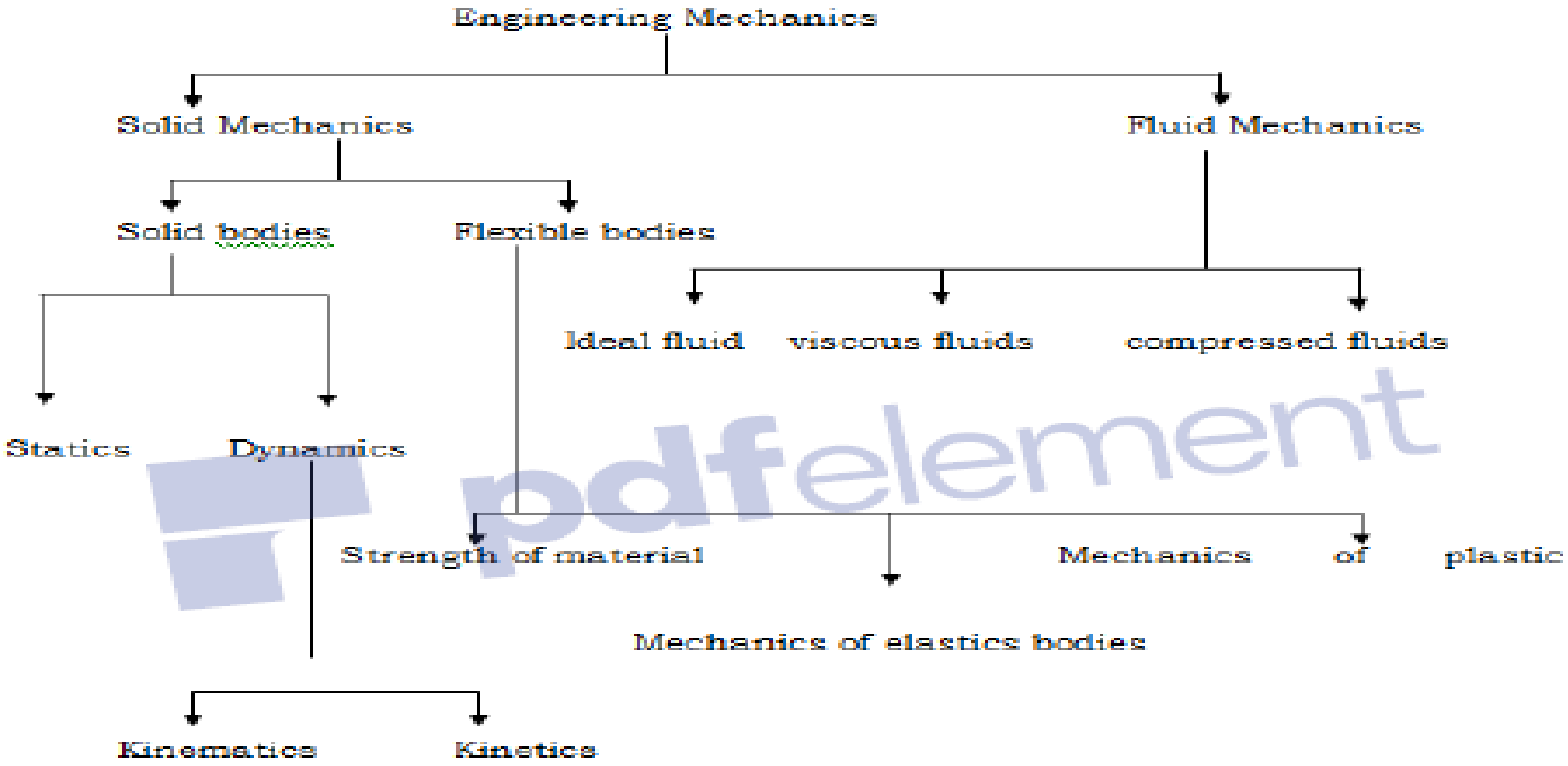
MECHANICS

Lecture No.1

د. محمد سعد

Introduction

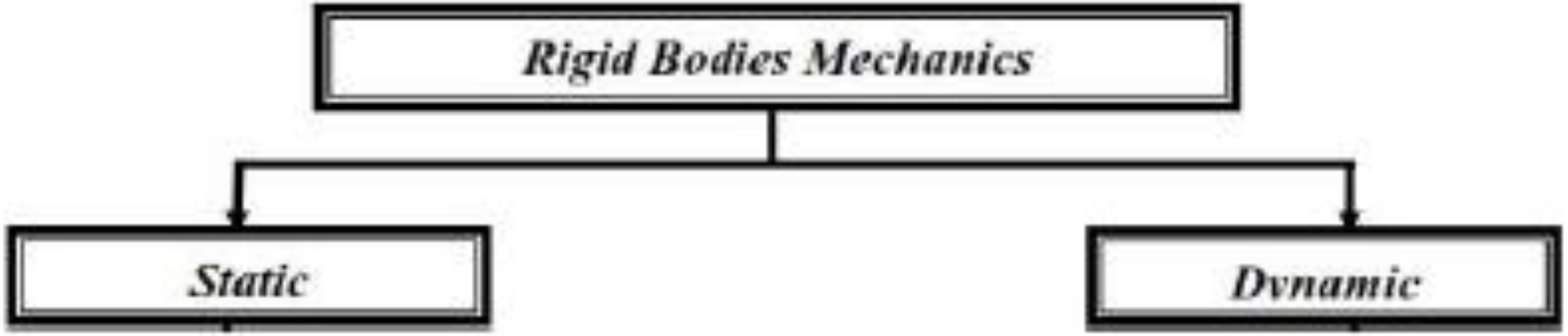
Mechanics is the branch of physical science that deals with rigid body or **engineering mechanic** is essentially a study of the effects of forces acting on bodies.



When change in shape of body important, the problem becomes **Deformable bodies mechanics (Strength of material)**

Rigid body is a body in all particles remains at fixed distance from each other's.

No real body is absolutely rigid, but in many cases the changes in shape of the body have a negligible effect upon the acceleration produced by a forced system or upon the reactions required to maintain equilibrium. Whenever the changes in distance between the particles of a body can be neglected, the body is assumed to be rigid.


Rigid Bodies Mechanics
Static
Dynamic

- When the force system acting on a body is equal zero (the body is in equilibrium), the branch of mechanics is called **Static**.

- When the force system acting on a body isn't equal zero (the body isn't in equilibrium), the branch of mechanics is called **Dynamic**.

Scalar and vector quantities

Physical quantities such as force, mass, acceleration, volume, velocity, and time used in engineering mechanics can be classified as either scalar or vector quantities.

Vector quantities are the quantities which have magnitude and direction such as: force, weight, velocity, distance, acceleration, displacement.

Scalar quantities are the quantities which have magnitude only such as: time, size, sound, density and light.

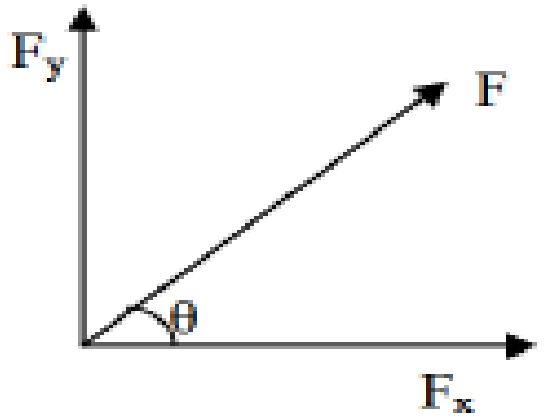
Force is an action that changes or tends to change the state of the motion of the body upon which it acts. It is a vector quantity that can be represented either mathematically or graphically.

A complete description of a force included:

- Magnitude.
- Direction .
- Point of action.

Resolving a force components.

The force F can be resolved into two components Fx and Fy along the x and y axes and hence, the components are called rectangular components. Use the parallelogram law to solve this problem.



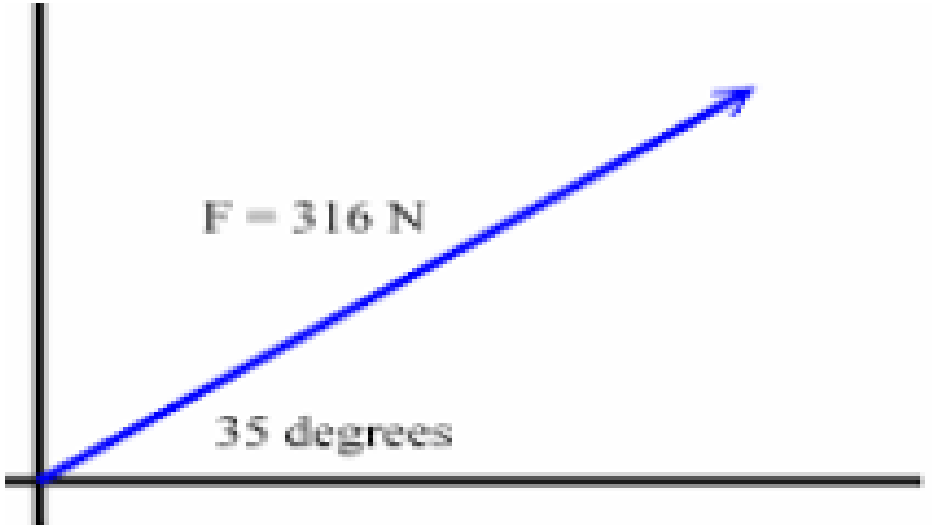
$$F_x = F * cos\theta$$

$$F_y = F * sin\theta$$

$$F = \sqrt{F_x{}^2 + F_y{}^2}$$

$$\theta = \tan^{-1}\frac{F_y}{F_x}$$

Example (1): Find the components F=316 N in the x and y direction with angle 35°



Sol.

$$F_x = F * cos\theta$$

$$F_x = 316 * cos35 = 258.85\ N$$

$$F_y = F * sin\theta$$

$$F_y = 316 * sin35 = 181.25\ N$$

Example (2): The magnitudes of two compositions perpendicular to the specific force are Fx=400N and Fy = 300N, calculate the force magnitude and direction, the angle with the horizontal line.

Sol.

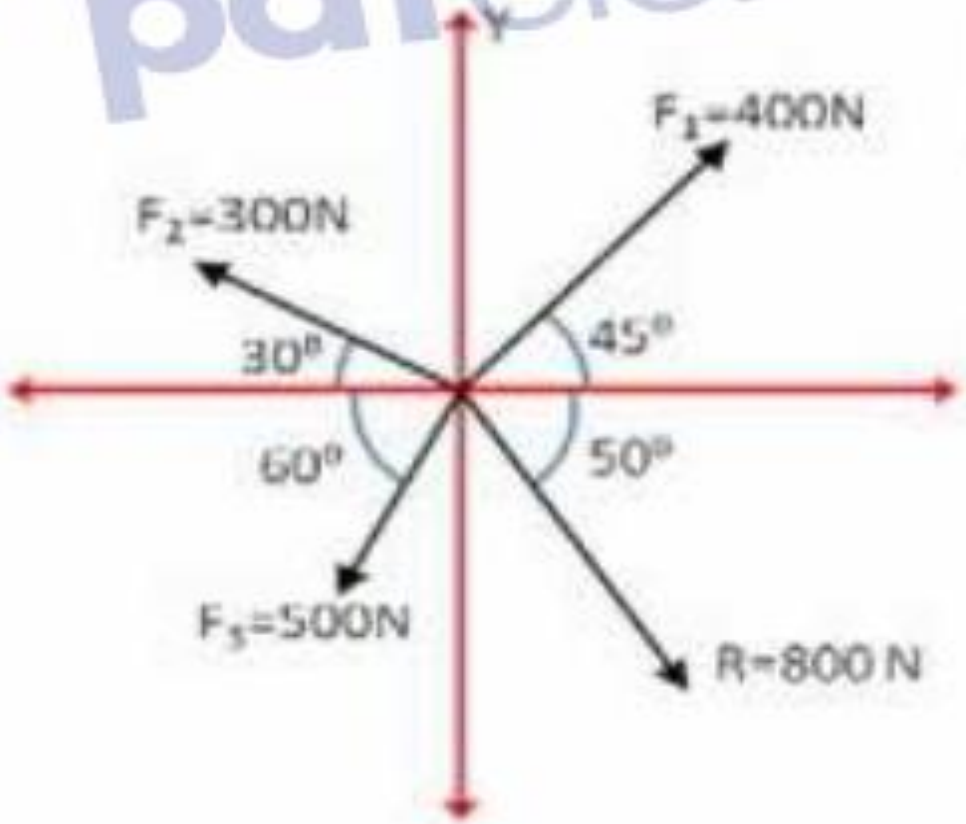
$$F = \sqrt{F_x{}^2 + F_y{}^2}$$

$$F = \sqrt{(400)^2 + (300)^2} = 500\ N$$

$$\theta = \tan^{-1}\frac{F_y}{F_x}$$

$$\theta = \tan^{-1}\frac{300}{400} = \tan^{-1} 0.75 = 36.8\,^\circ$$

Example (3): Find the resultant for system forces as shown in fig. below:



Sol.

$$F_x = F * cos\theta$$

$$F_y = F * sin\theta$$

For F1 = 400 N & θ = 45 °

$$F1_x = 400 * cos45 = 282.8\ N$$

$$F1_y = 400 * sin45 = 282.8\ N$$

For F2 = 300 N & θ = 30 °

$$F2_x = 300 * cos30 = 259.8\ N$$

$$F2_y = 300 * sin30 = 150\ N$$

For F3 = 500 N & θ = 60 °

$$F3_x = 500 * cos60 = 250$$

$$F3_y = 500 * sin60 = 433\ N$$

For R = 800 N & θ = 50 °

$$R_x = 800 * cos50 = 514\ N$$

$$R_y = 800 * sin50 = 383\ N$$

$$\sum F_x = 282.8 - 259.8 - 250 + 514 = 287\ N$$

$$\sum F_y = 282.8 + 150 - 433 - 383 = -283.2$$

$$F = \sqrt{F_x{}^2 + F_y{}^2}$$

$$F = \sqrt{(287)^2 + (-283.2)^2} = 403.2\ N$$

Thank you for listening