



Chemical Engineering and Petroleum Industries

Engineering Mechanics

First Stage

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Course Code	CHE 116	Credit hr.				Credits
Course Title	Engineering Mechanics					
Year / Term	First Year 1 st Semester	Theoretical	Practical	Tutorial	Total	
Specialization		2	0	1	3	2

Course Syllabus

1- Principles of statics

Basic concepts, Rigid bodies, Force systems, Scalar and Vector quantities.

2- Resultants of Force Systems and Equilibrium

Resultants of two dimensional concurrent & non- concurrent force systems, Free body diagram, Condition of Equilibrium, Moment of a force, Applications of equilibrium of forces , Systems .

3- Friction

Theory of friction, Friction on inclined plane, Equilibrium of bodies involving dry friction.

4- Centroid and center of gravity

Centroid of plane, curve, area, volume and composite bodies.

5- Moment of Inertia

Moment of Inertia of plane area, Parallel and Perpendicular axis theorems, Principal moment of Inertia, Polar moment of inertia, Mass moment of inertia.

References:

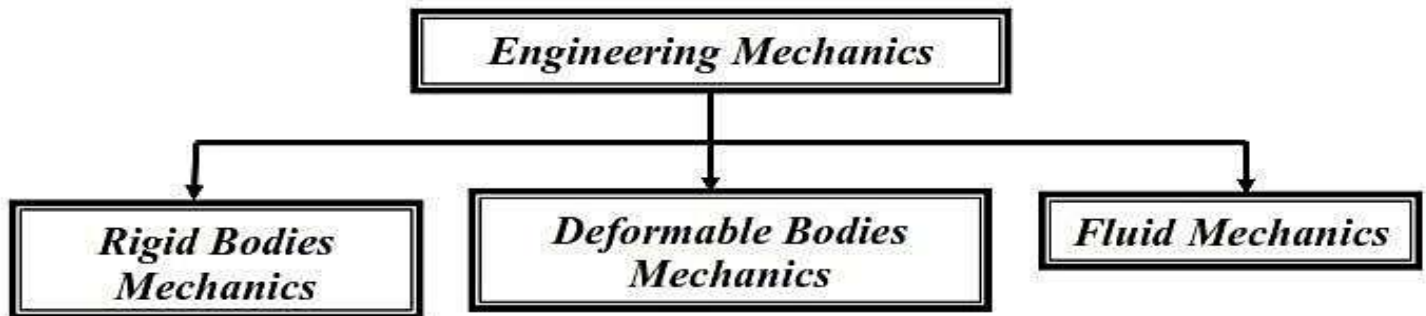
1. "Engineering Mechanics" F. L. Singer
2. "Engineering Mechanics" A. Higdon
3. " Mechanics for Engineering " F. P. Beer



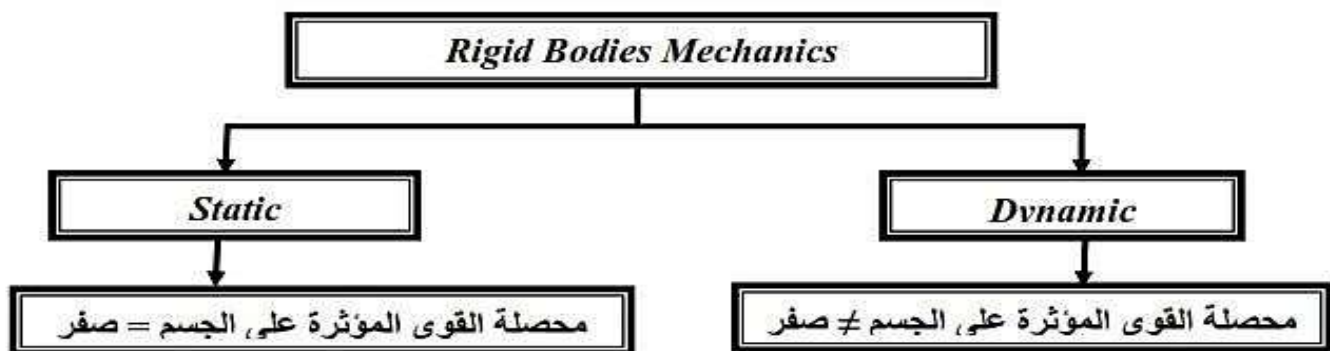
1. Introduction:

Mechanics: can be defined as that branch of the physical sciences concerned with the state of bodies that are subjected to the action of forces (in the state of motion or rest)

الميكانيك يعرف بأنه جزء من العلوم الفيزيائية التي تركز على حالة الاجسام تحت تأثير القوى الخارجية المسلطة على هذه الاجسام.



- When the changes in shape of body are important, the problem becomes **Deformable Bodies Mechanics**.
- Our study treats only with **Rigid Bodies Mechanics**, so that the body is stay in the same shape after applying the forces (No deformations are considered in the body). (دراستنا سوف تكون على الاجسام الغير قابلة للتشوه (الاجسام الجاسنة).



- **Static** deals with the equilibrium of bodies. That are either at rest or move with a constant velocity. (الاجسام سوف تكون في حالة توازن اما ساكنة او متحركة بسرعة ثابتة)
- **Dvynamic** is concerned with the accelerated motion of bodies under effects of external forces. (الاجسام سوف تكون في حالة حركة متغيرة)

**Vector & Scalar quantities :**

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

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

Force :

A "force" is an action that changes, or tends to change, the state of 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 MUST include its:

1. MAGNITUDE
2. DIRECTION and SENSE
3. POINT OF ACTION

هي الفعل الذي يغير او يحاول ان يغير من حالة الجسم الحركية او الشكلية، والقوة لها مقدار (Magnitude) واتجاه (Direction) ووجهة (Sense) ونقطة تأثير (Action point)

Classification of Forces

✓ Contact

- 1 – Contacting or surface forces (mechanical)
- 2 – Non-Contacting or body forces (gravitational, weight)

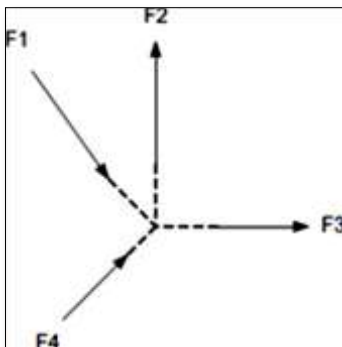
✓ Area

- 1 – Distributed Force, uniform and non-uniform
- 2 – Concentrated Force

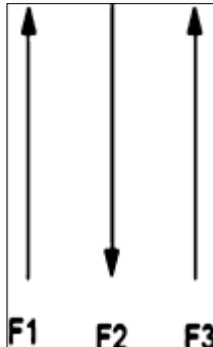
Classification of Forces

✓ Force System

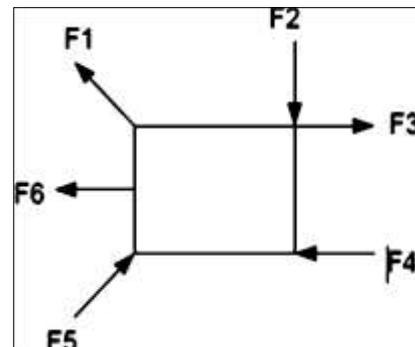
- 1 – Concurrent : all forces pass through a point
- 2 – Coplanar : in the same plane
- 3 – Parallel : parallel line of action
- 4 – Collinear : common line of action



Concurrent Coplanar



Parallel



Collinear

Figure (1):Force System



For example: the force F as shown in the Figure (2) has a magnitude is 9 KN, and a direction is 30° measured from the horizontal axis.

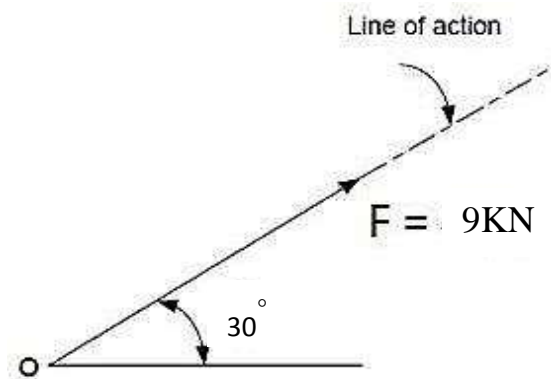


Figure (2) : Force is a vector quantity.

5-Couple: - consists of two equal and opposite parallel forces that do not have a common line of action.

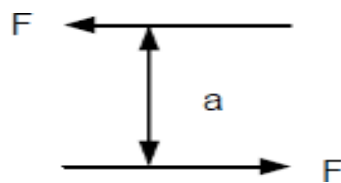


Figure (3):Couples.



Cosine Law:

$$A^2 = B^2 + C^2 - 2BC \cos \theta$$

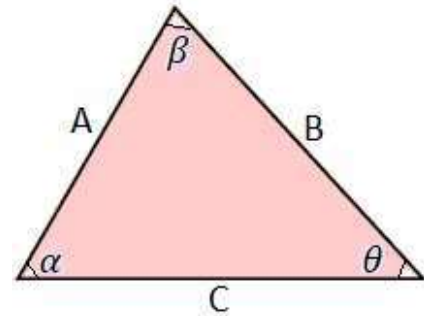
$$A = \sqrt{B^2 + C^2 - 2BC \cos \theta}$$

$$B^2 = A^2 + C^2 - 2AC \cos \alpha$$

$$B = \sqrt{A^2 + C^2 - 2AC \cos \alpha}$$

$$C^2 = A^2 + B^2 - 2AB \cos \beta$$

$$C = \sqrt{A^2 + B^2 - 2AB \cos \beta}$$



Sine Law:

$$\frac{A}{\sin \theta} = \frac{B}{\sin \alpha} = \frac{C}{\sin \beta}$$