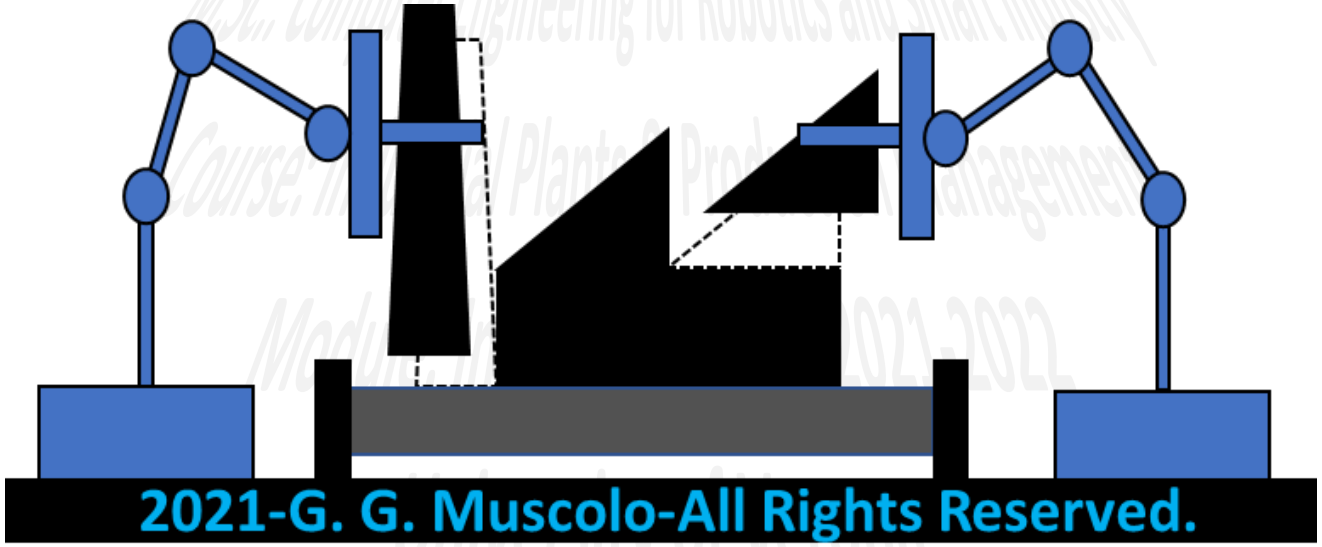

Industrial Plants

(S.S.D. ING-IND/13)

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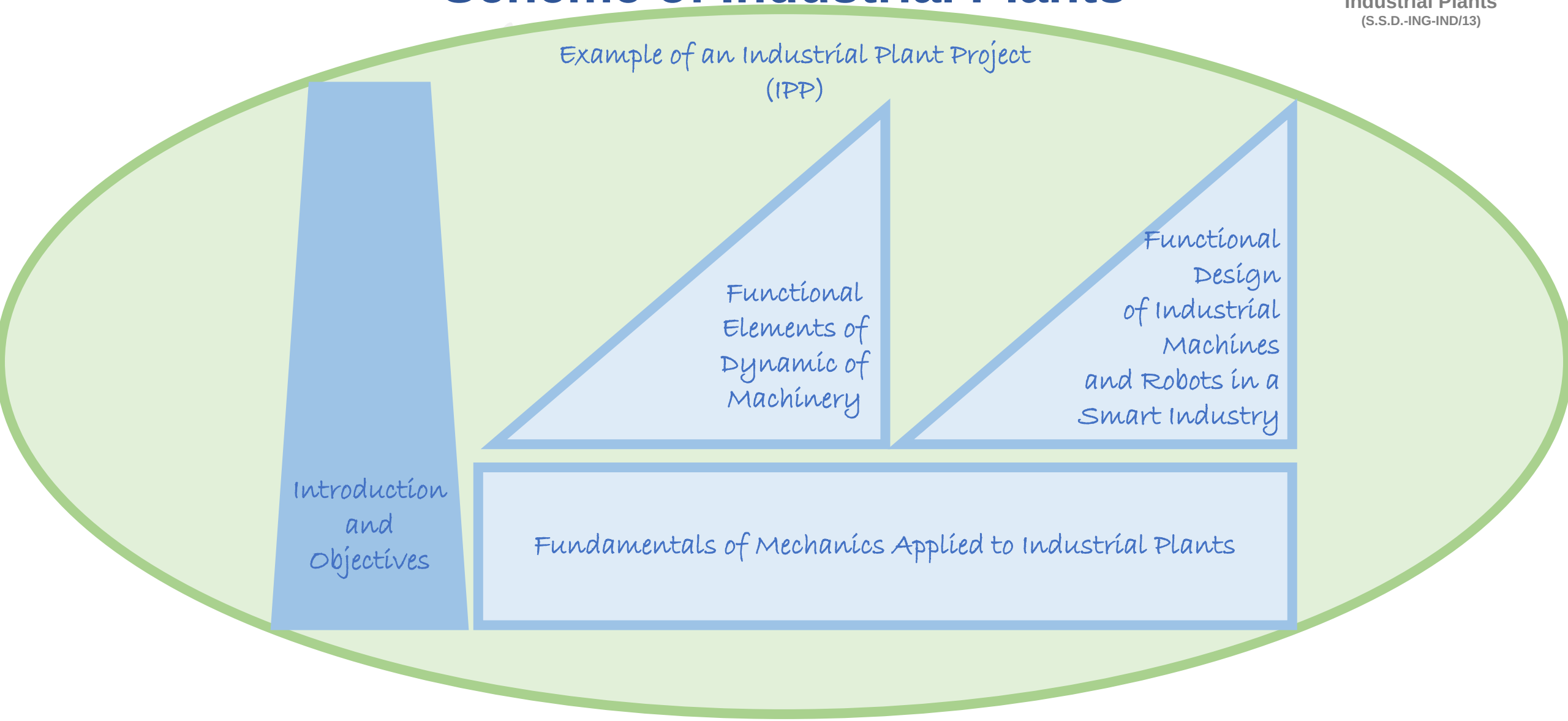
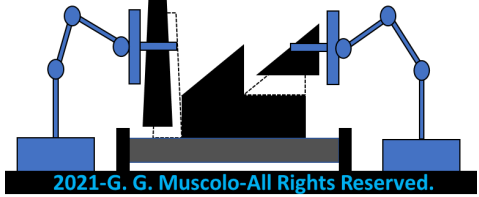
Program

1. **Introduction and Objectives**
2. **Fundamentals of Mechanics Applied to Industrial Plants**
3. Functional Design of Industrial Machines and Robots in a Smart Industry
4. Functional Elements of Dynamic of Machinery
5. Example of an Industrial Plant Project (IPP)

Scheme of Industrial Plants





EXAMPLE (dynamics):

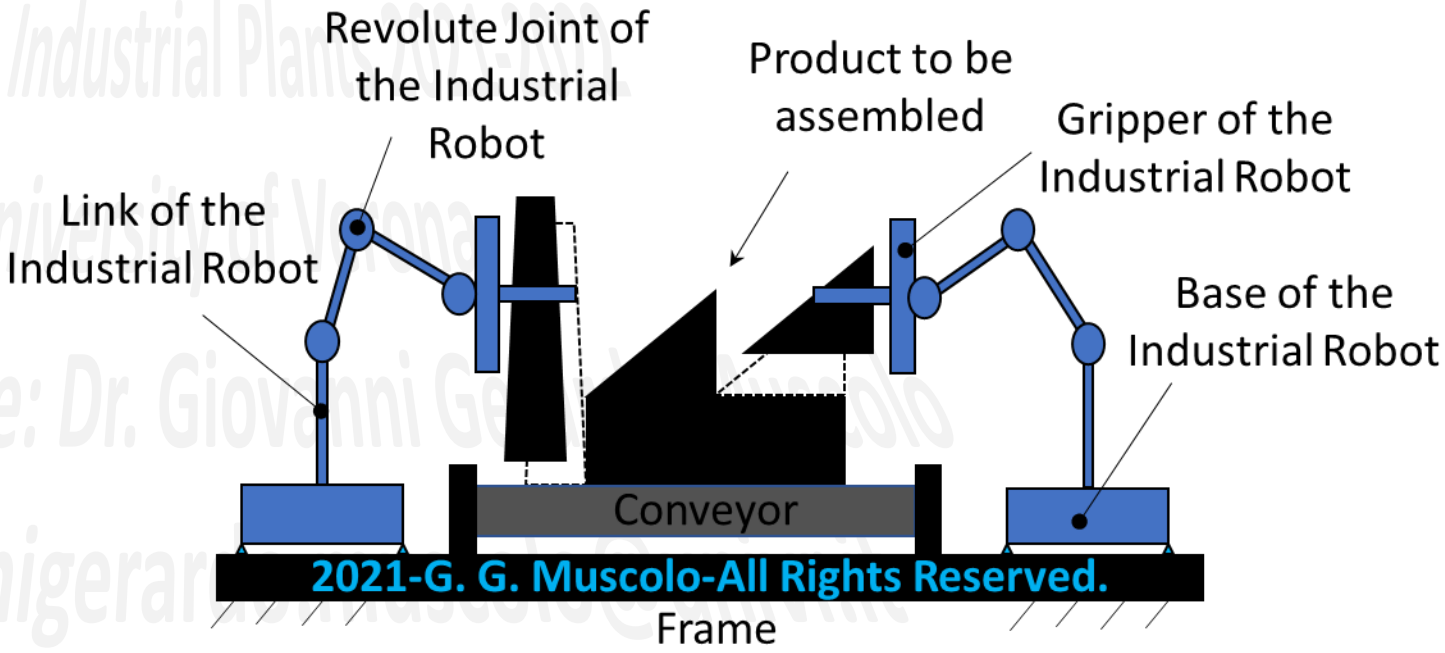
Critical points in the assembling process

1) Balancing (robot, components);

2) Interactions (robot/robot, robot/conveyor, robot/components);

3) Precision and repeatability;

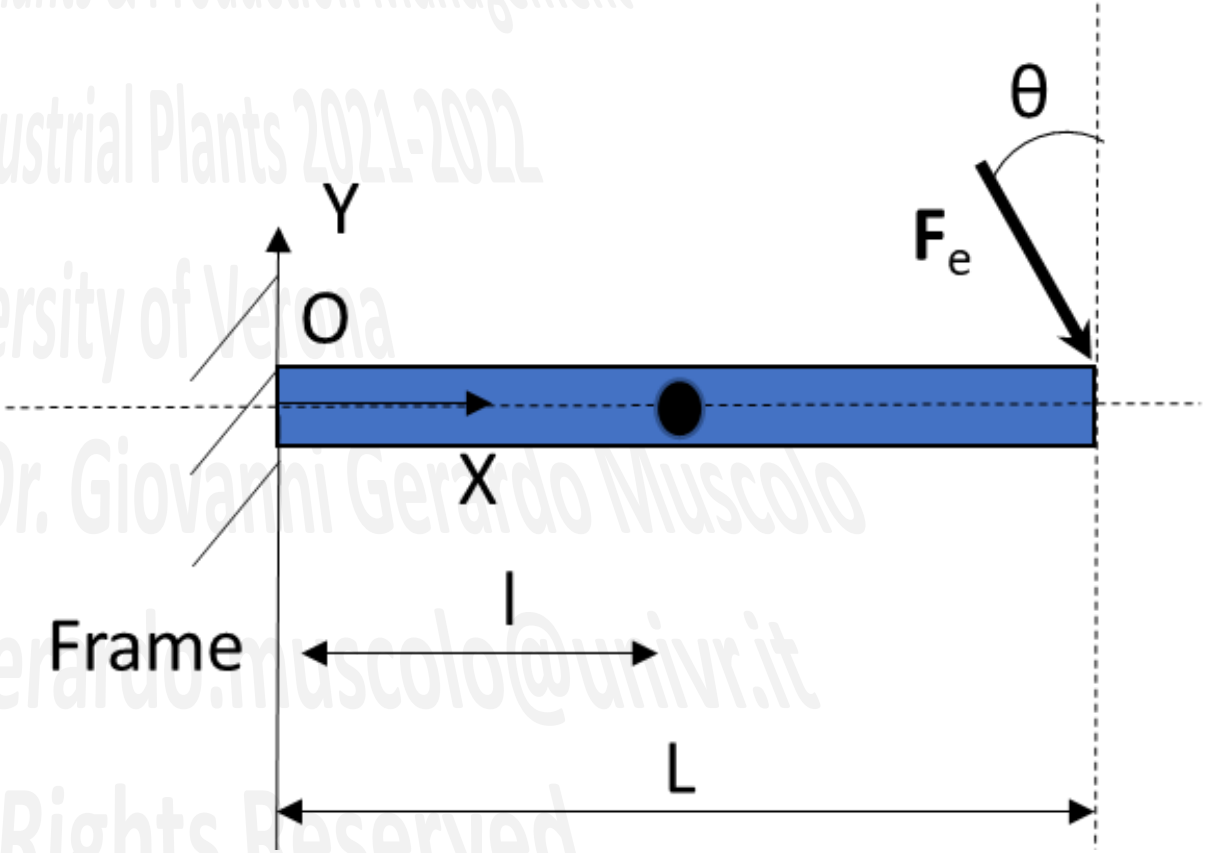
Etc…



EXAMPLE (dynamics):

Interactions

We may consider a real situation in which, an external force (F_e) interacts with our robot during the assembling process.



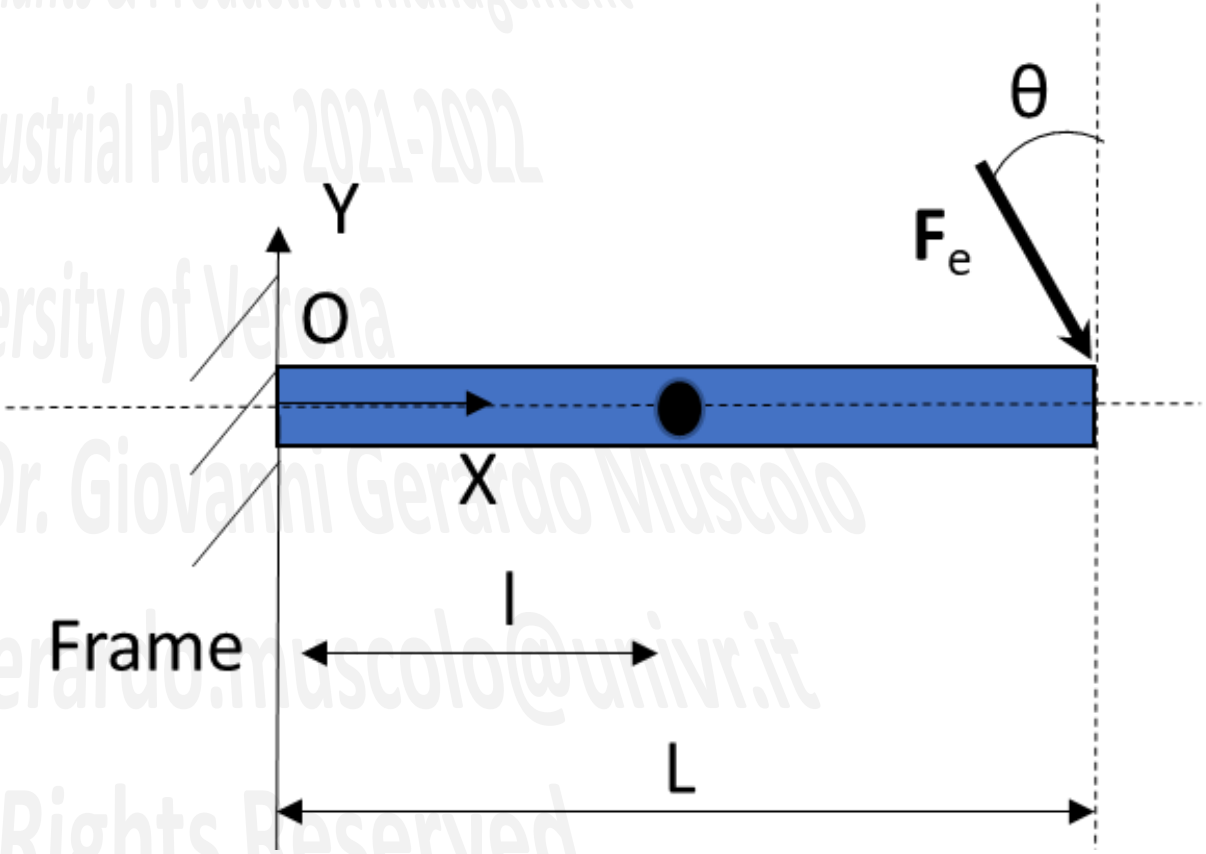
EXAMPLE (dynamics):

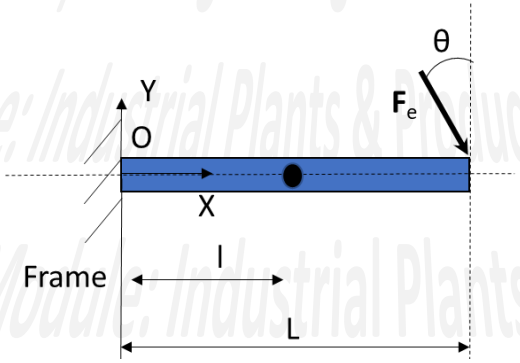
Interactions

The balancing conditions are shown in follows:

$\sum F = 0$; Resultant of all forces

$\sum M = 0$; Resultant of all torques





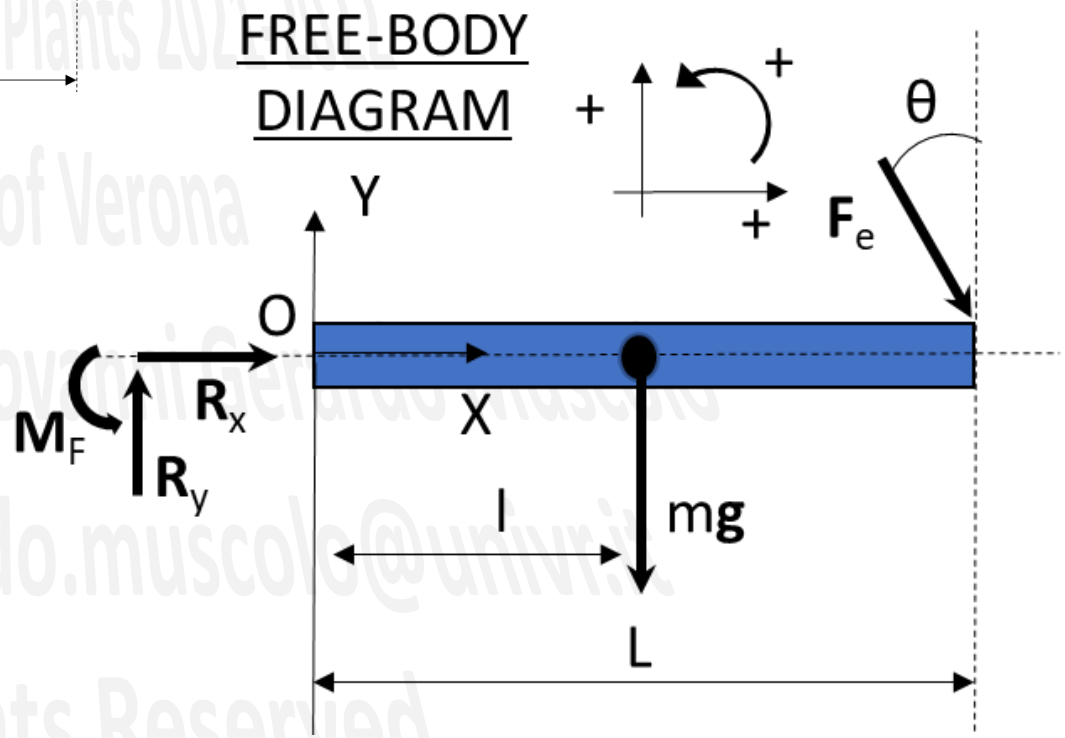
EXAMPLE (dynamics):

Interactions

$$\sum F_X = 0 = F_e \sin(\theta) + R_x;$$

$$\sum F_Y = 0 = R_y - mg - F_e \cos(\theta);$$

$$\sum M_O = 0 = M_F - F_e \cos(\theta)\,\mathrm{L} - mgl;$$



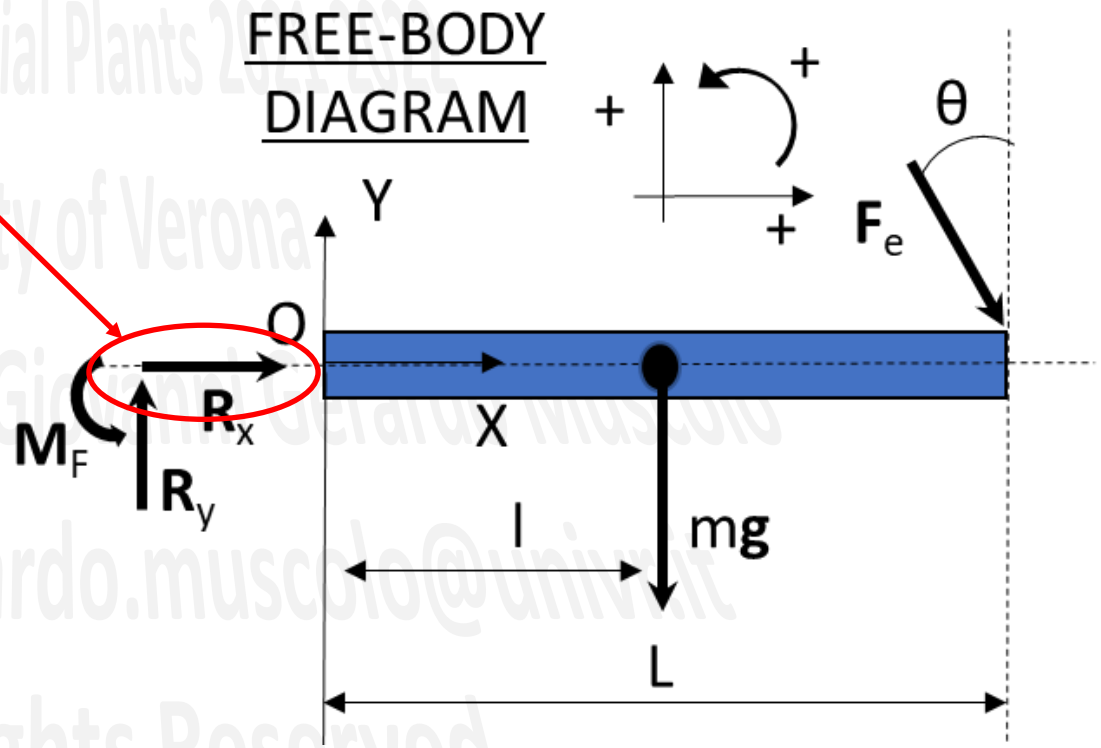
EXAMPLE (dynamics):

Interactions

$$R_x = -F_e \sin(\theta);$$

$$R_y = mg + F_e \cos(\theta);$$

$$M_F = F_e \cos(\theta)\,\mathrm{L} + mgl;$$



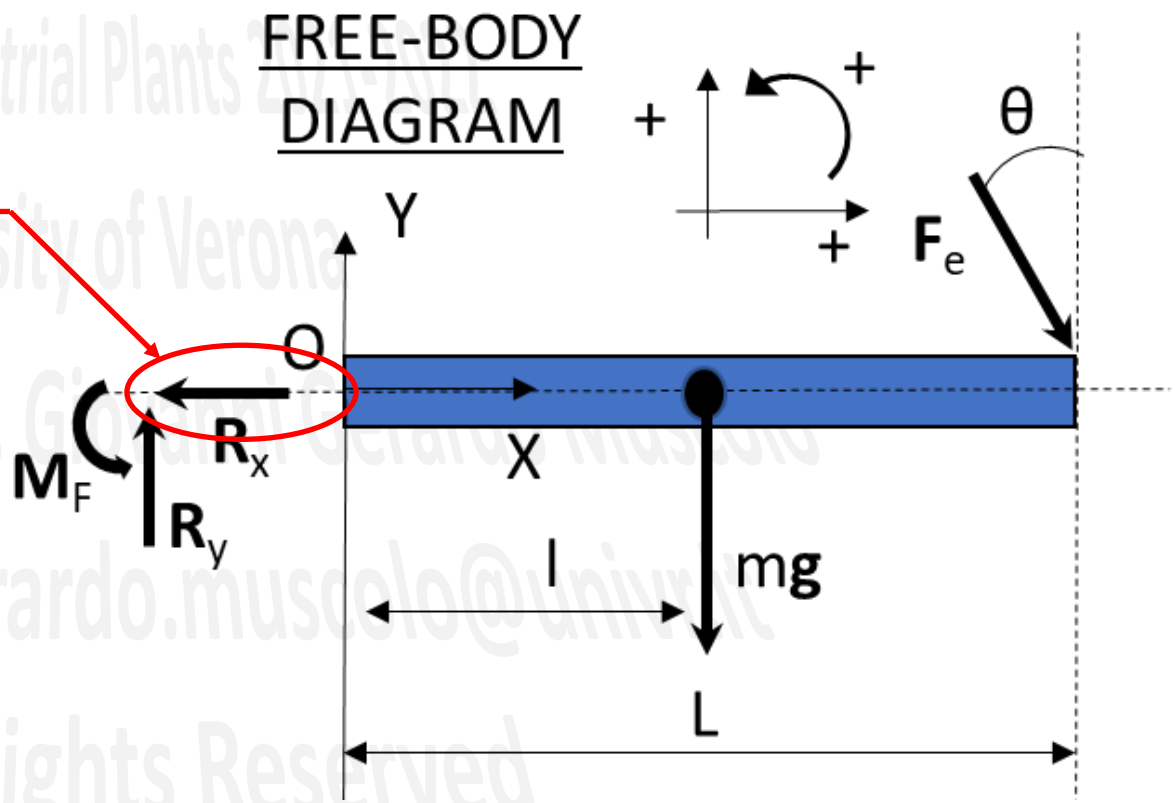
EXAMPLE (dynamics):

Interactions

$$R_x = +F_e \sin(\theta);$$

$$R_y = mg + F_e \cos(\theta);$$

$$M_F = F_e \cos(\theta)\,\mathrm{L} + mgl;$$



EXAMPLE (dynamics):

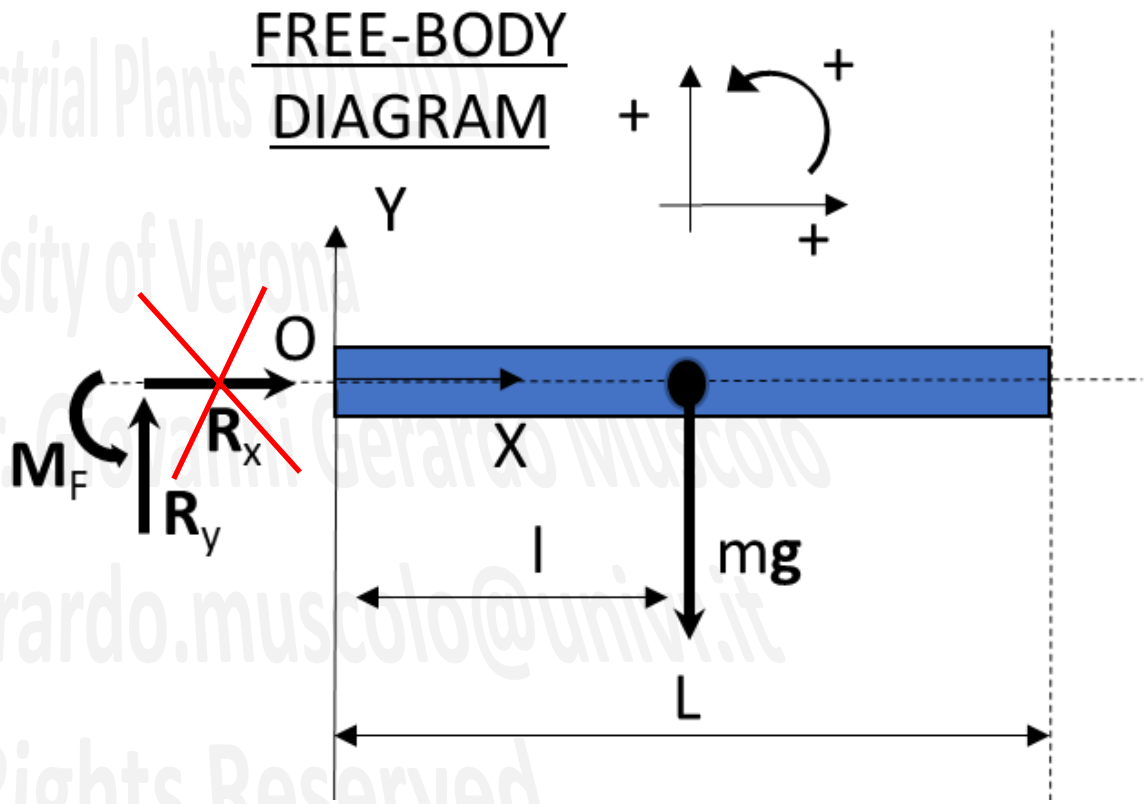
Interactions

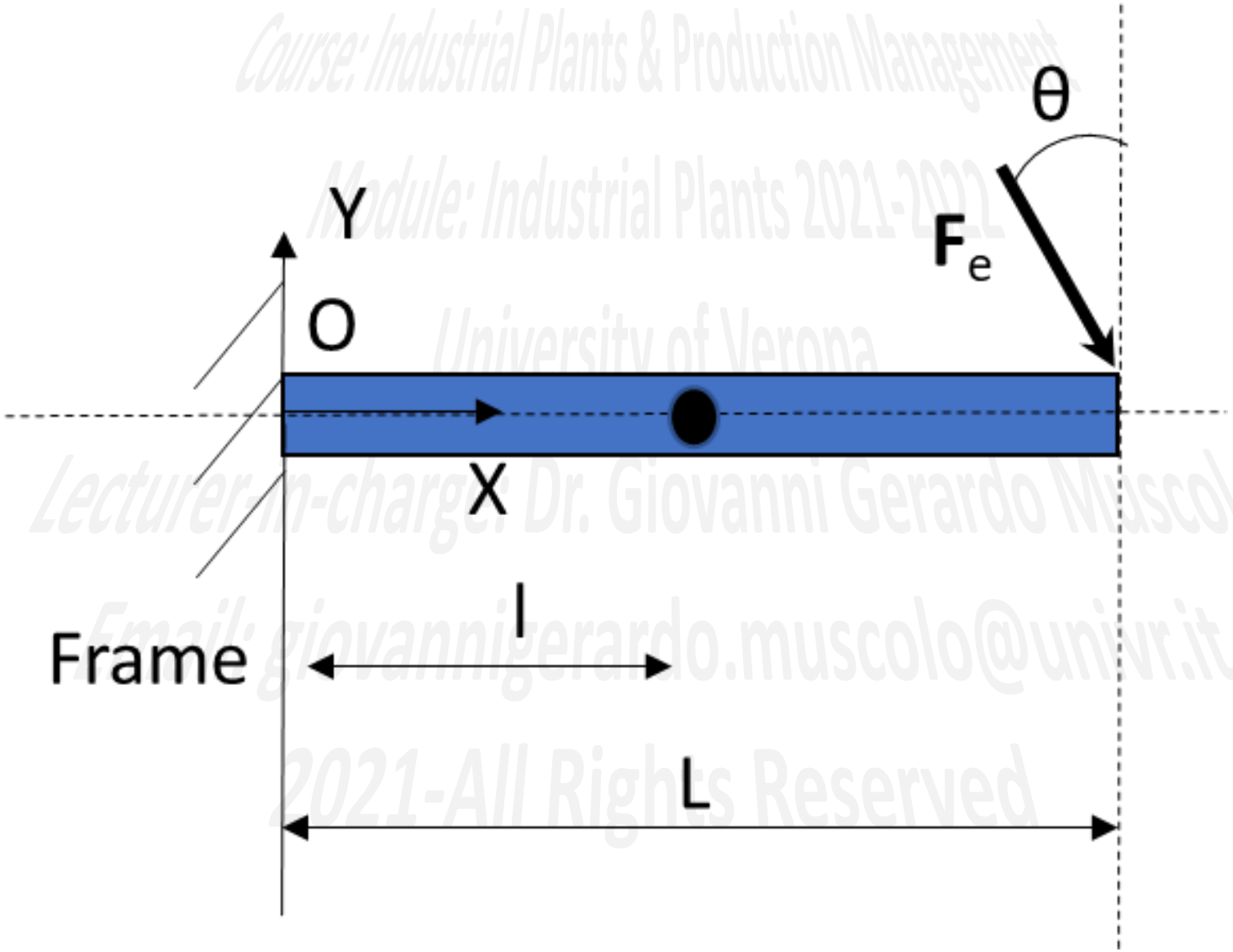
Case without external forces

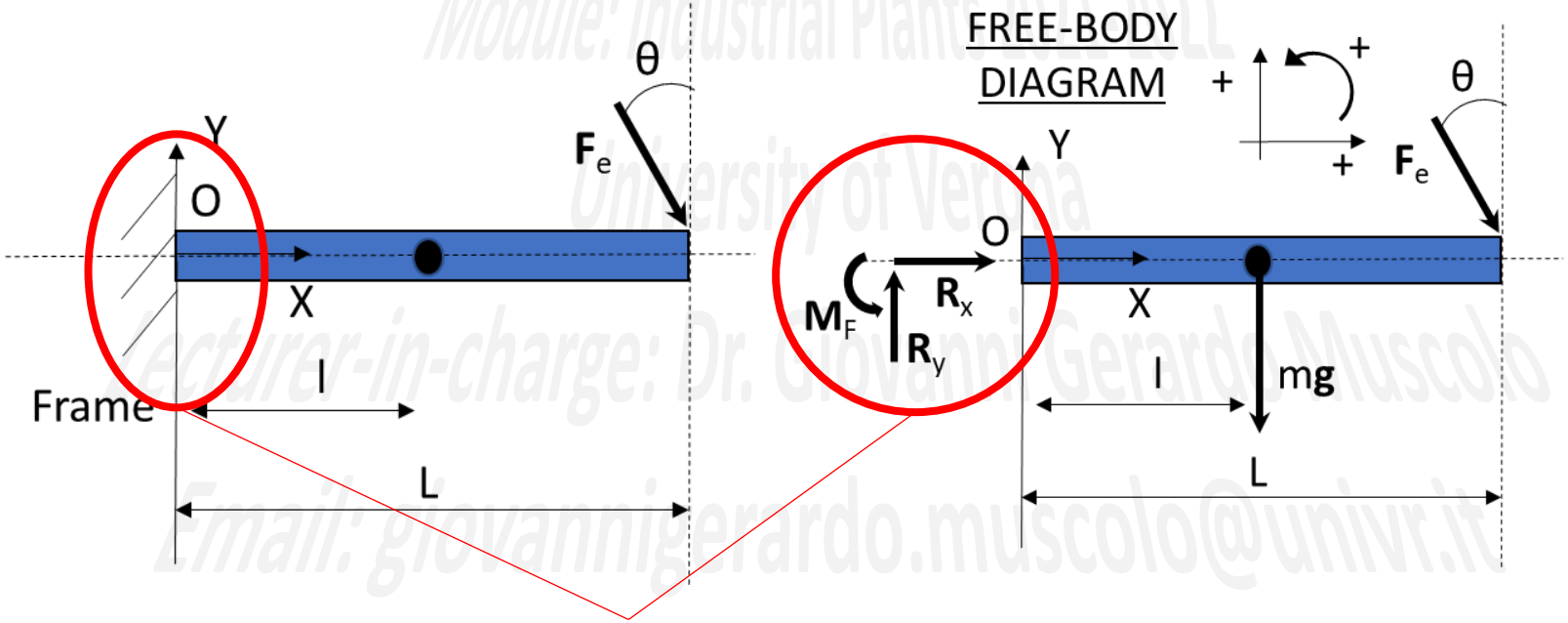
$R_x = 0;$

$R_y = mg;$

$M_F = mgl;$

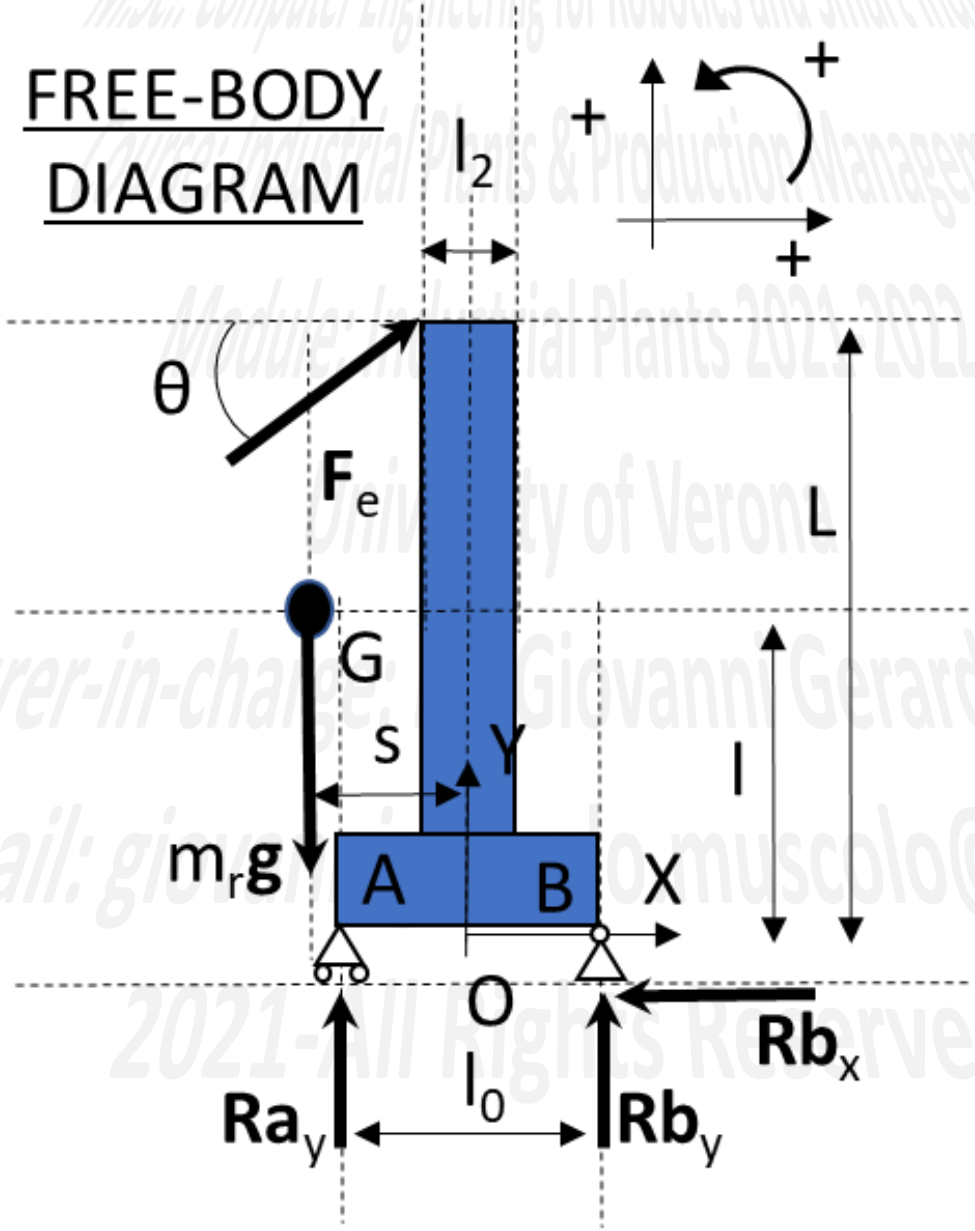


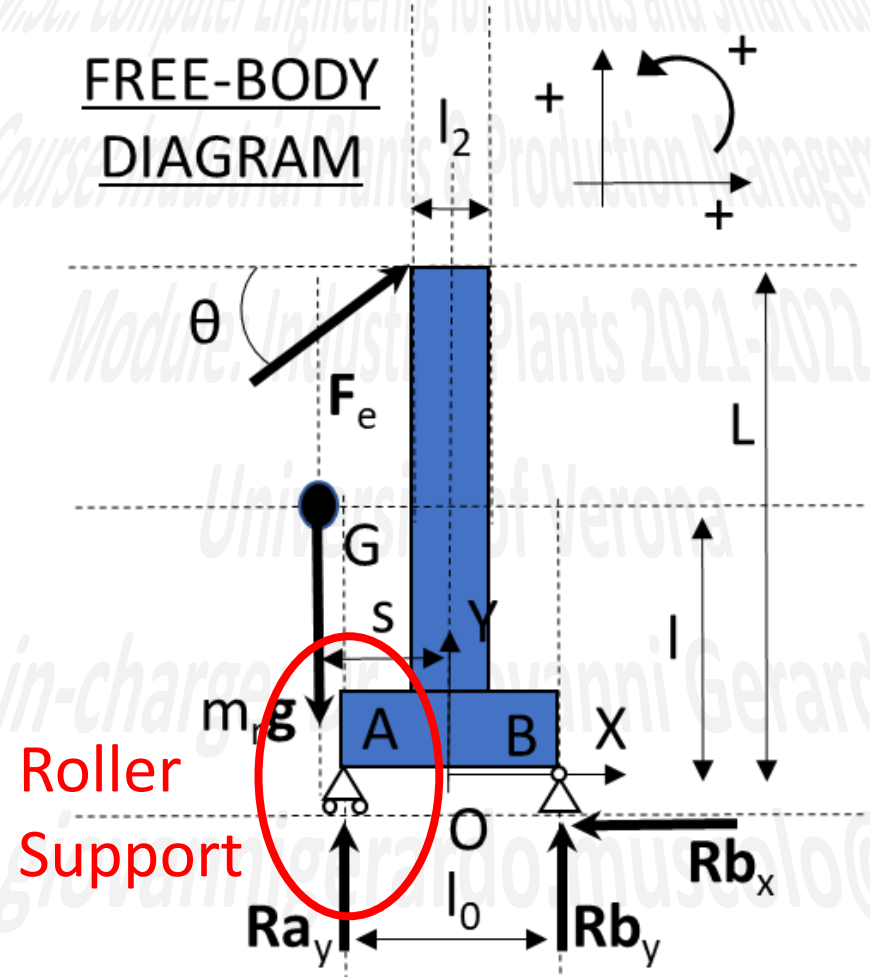


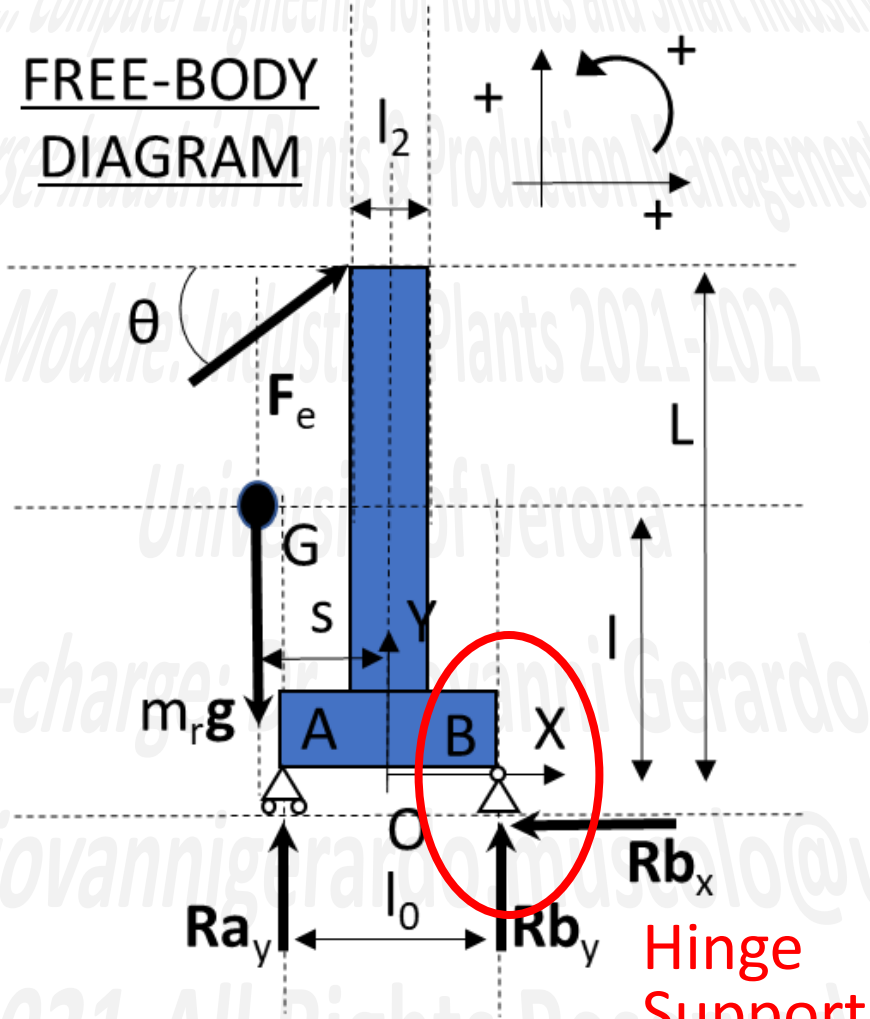


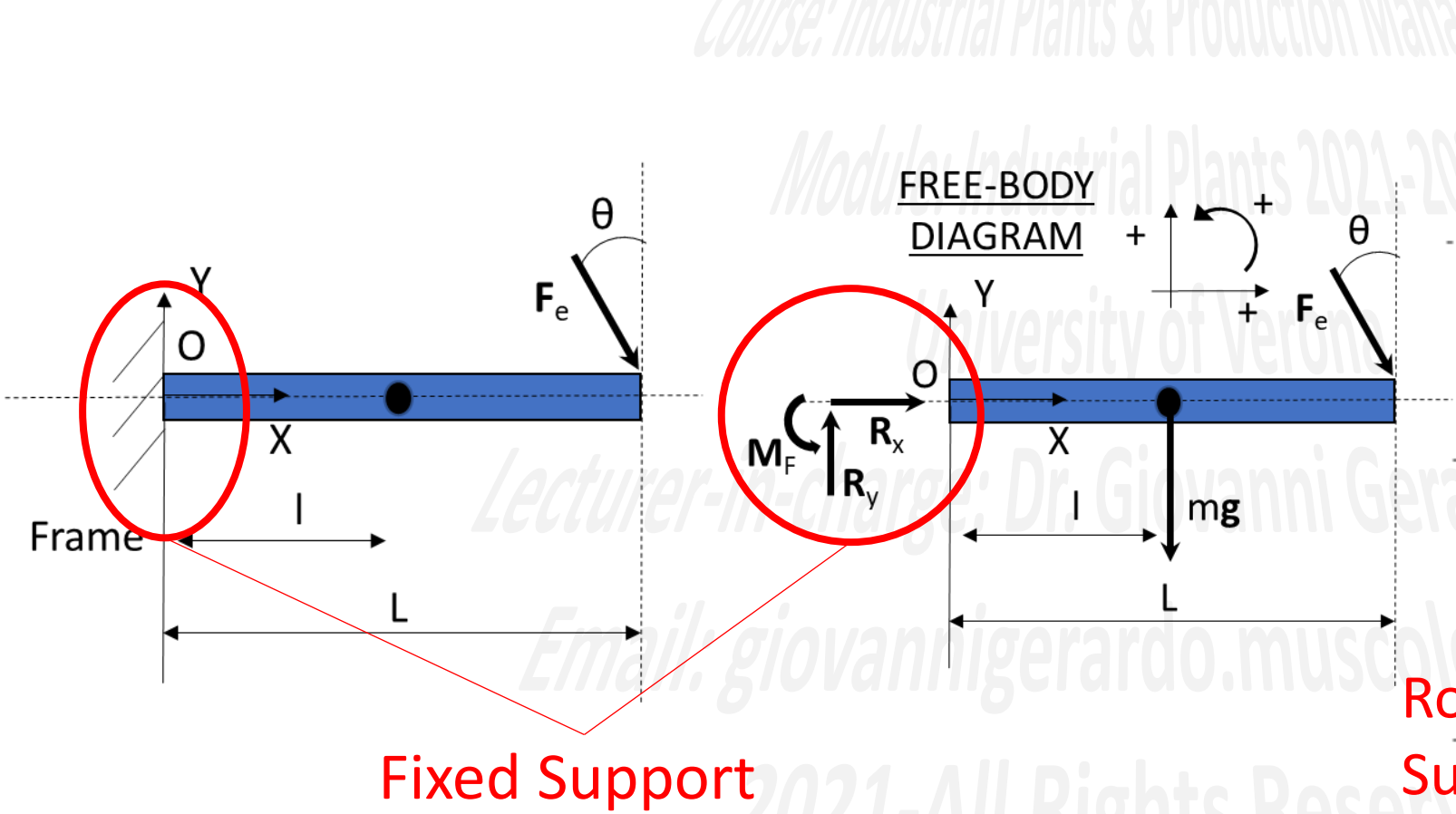
Fixed Support

FREE-BODY DIAGRAM

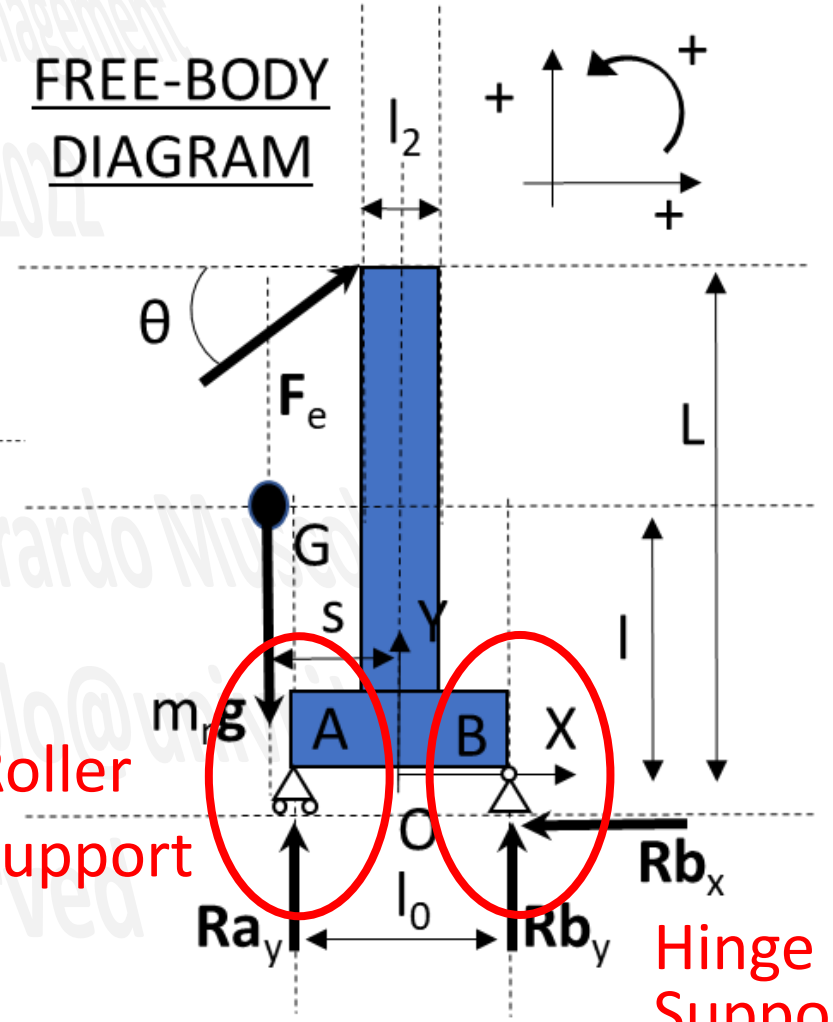








Fixed Support

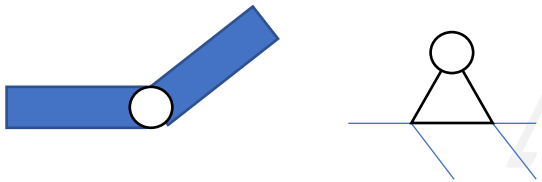


Roller Support

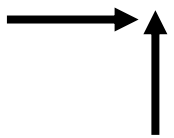
Hinge Support

Reaction Forces (dynamics):

Hinge Support



Components of the Reaction Force

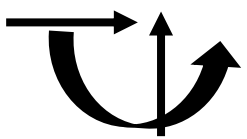


Roller Support

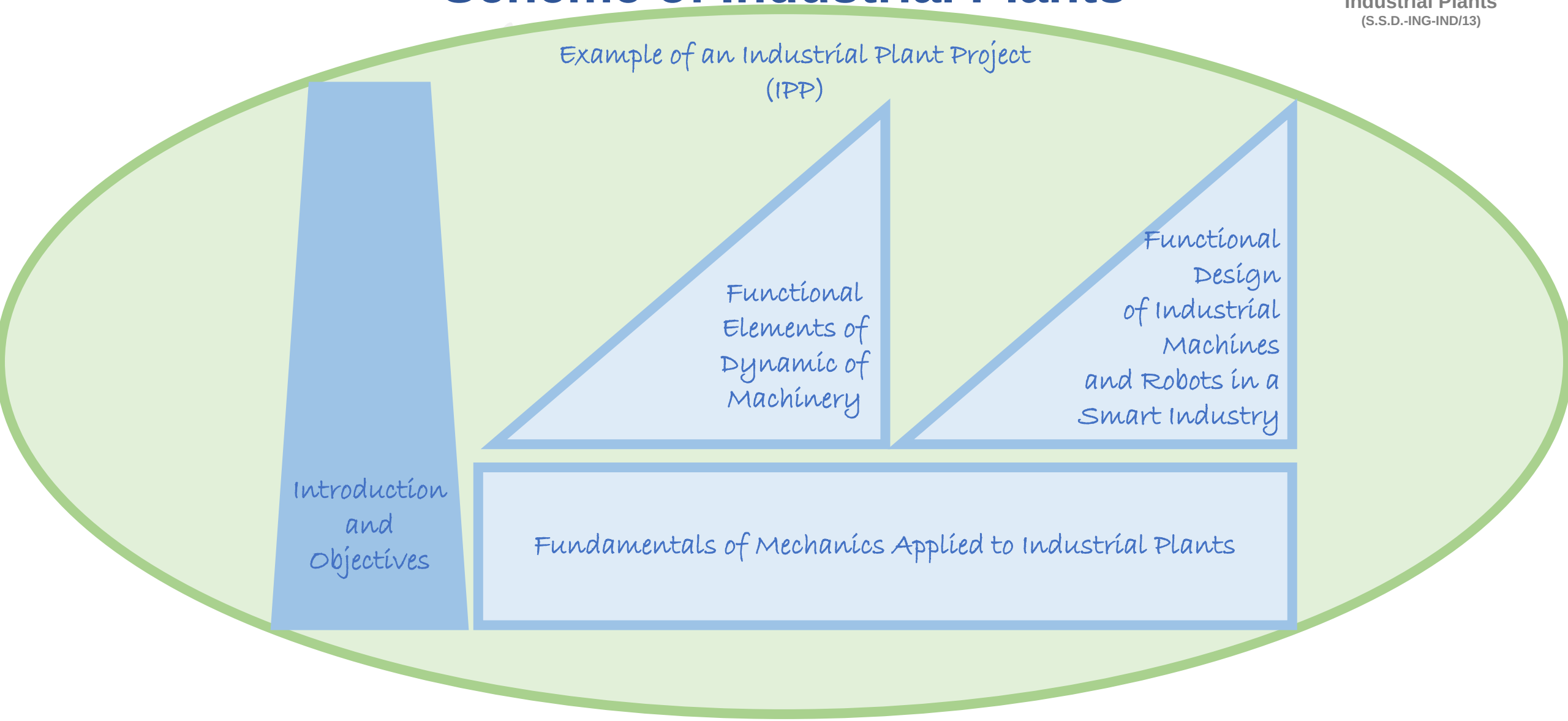
Components of the Reaction Force

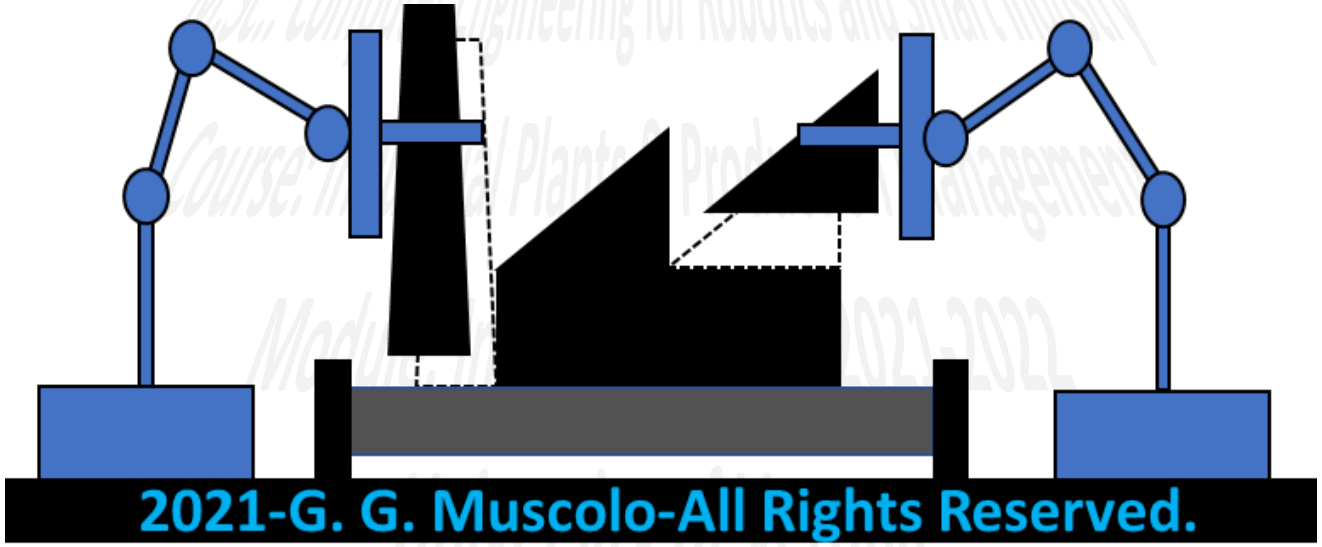
Fixed Support

Components of the Reaction Force and Torque



Scheme of Industrial Plants





Industrial Plants

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