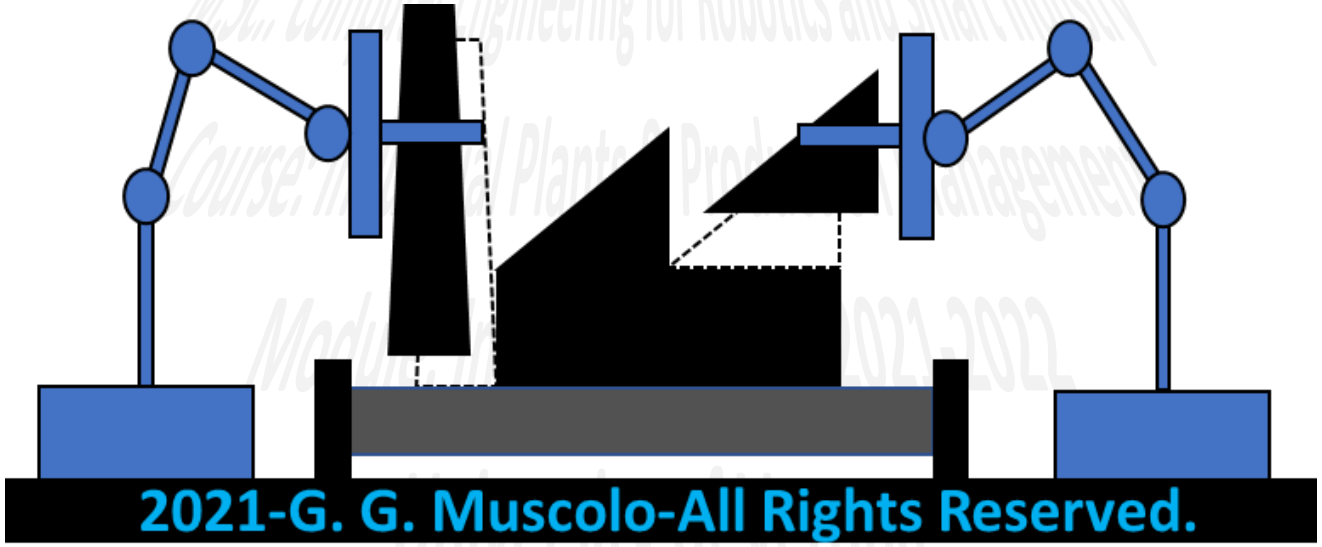


Industrial Plants

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

Dr. Giovanni Gerardo Muscolo
Assistant Professor in Applied Mechanics
(S.S.D.-ING-IND/13)

Email: giovannigerardo.muscolo@univr.it

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer-in-charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

2021-G. G. Muscolo-All Rights Reserved.

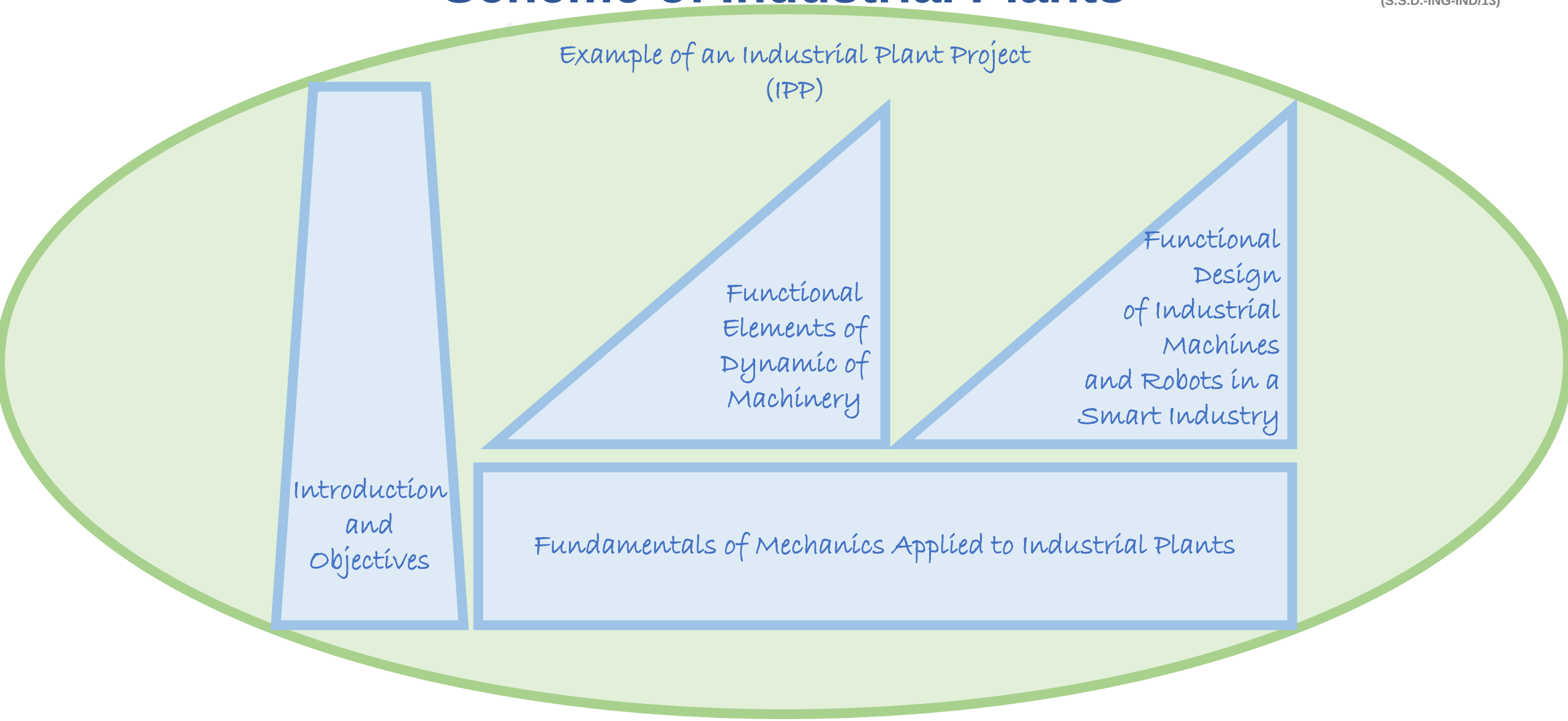
M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer in charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

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)

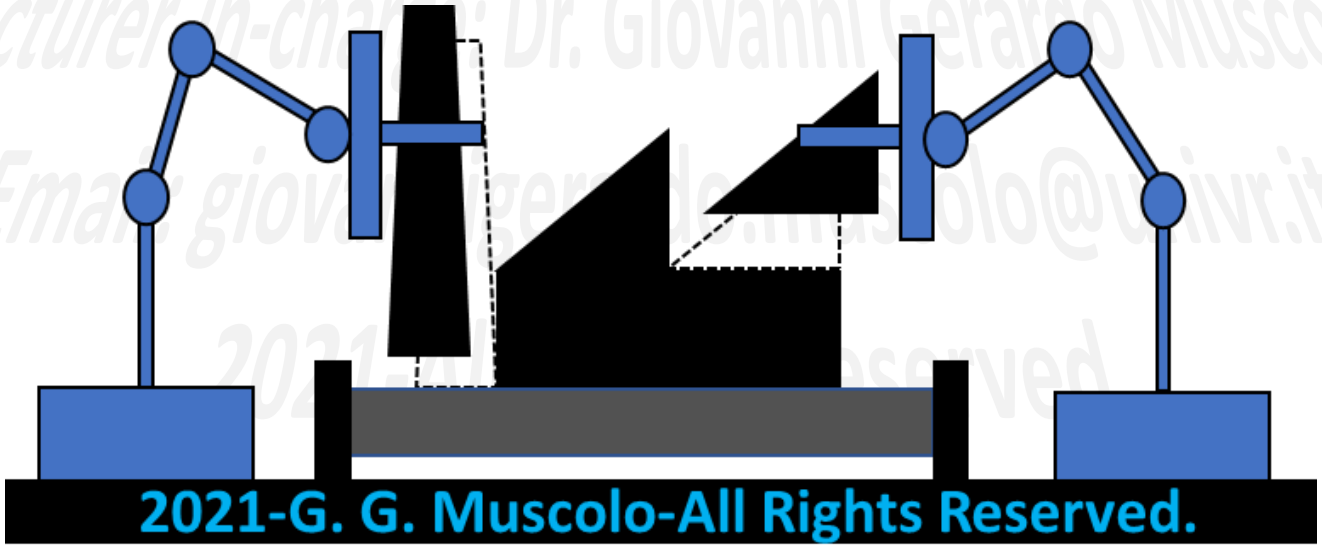
2021-G. G. Muscolo-All Rights Reserved.

Scheme of Industrial Plants



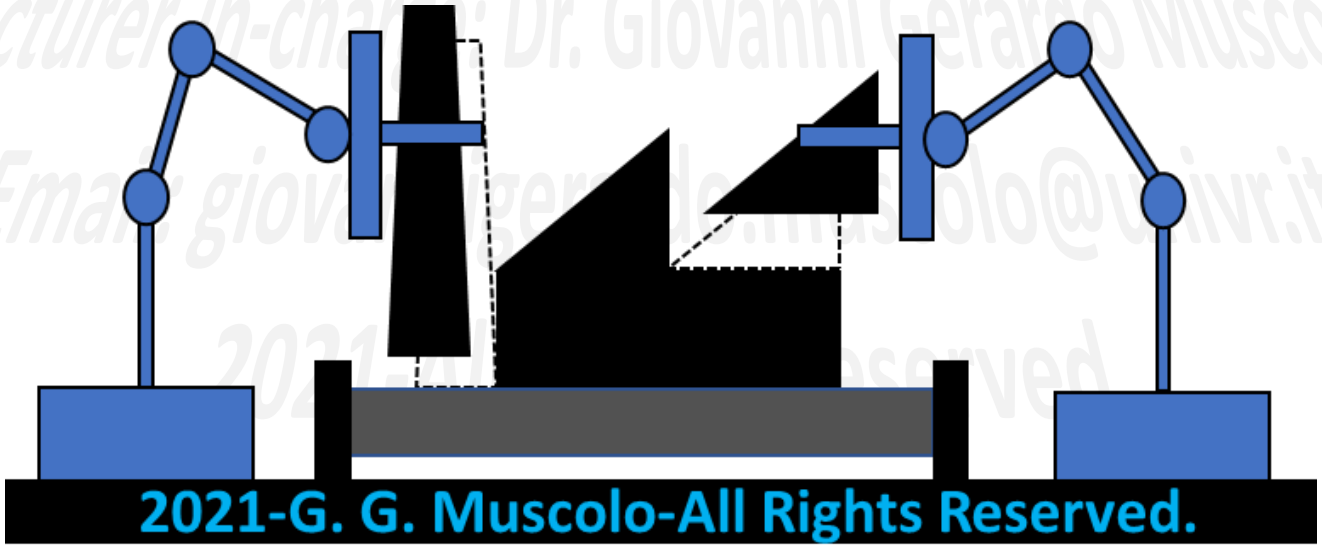
M.Sc. "Computer Engineering for Robotics and Smart Industry"
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer in charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-G. G. Muscolo-All Rights Reserved.

The "**Industrial Plants**" module aims at conceiving a methodological approach for solving industrial problems.



M.Sc. "Computer Engineering for Robotics and Smart Industry"
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer in charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-G. G. Muscolo-All Rights Reserved.

During the module, students will learn theoretical and applied methodologies for understanding **the mechanical/mechatronic behaviour of an industrial plant**.



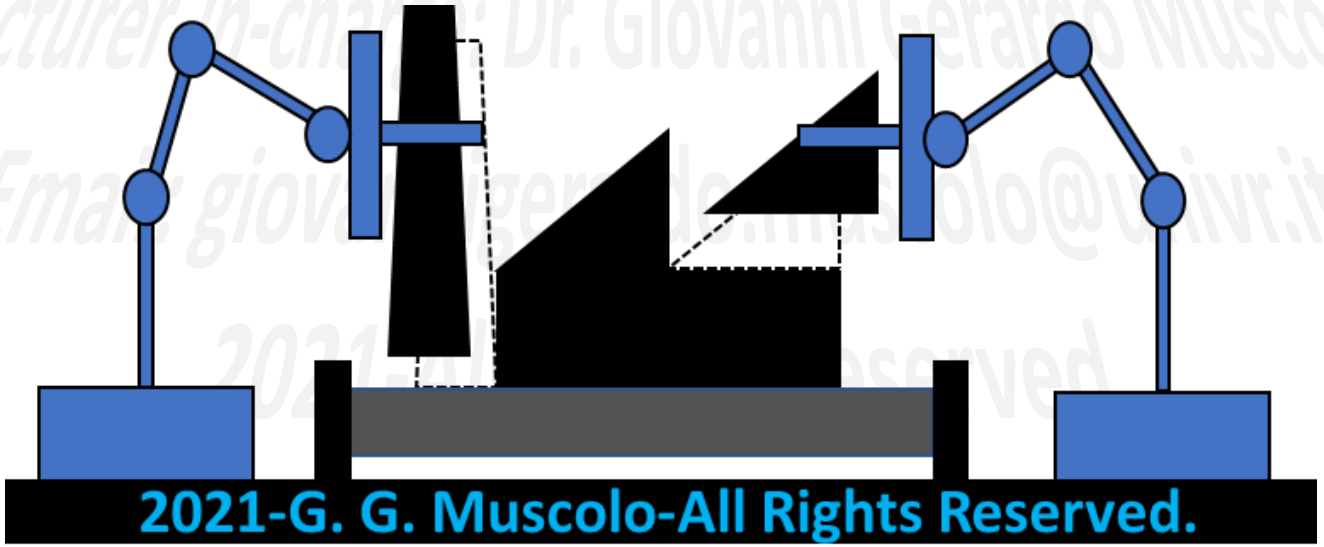
M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer in charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

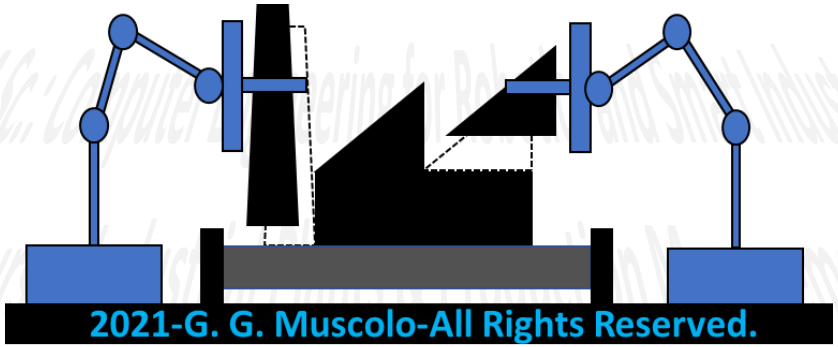
At the end of the module, students will be able to:

1) **discover critical components** in an industrial plant;

2) **propose solutions** to solve industrial problems;

3) **conceive** a very simple functional design of industrial components.





In general, the following phases (for solving industrial technical problems) will be studied in depth:

a) **analysis of critical points** in a real industrial system (real domain);

b) **synthesis of the real industrial** system developing a mechanical model (physical/analytical domain);

c) **analysis, validation, and simulation** of the developed mechanical model (physical/analytical domain);

d) **design, simulation, and validation** of a virtual model (virtual domain);

e) **analysis for the implementation** of the proposed solution in a real domain (physical/analytical/virtual/real domain).

2021-G. G. Muscolo-All Rights Reserved.

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants (ING-IND/13)
University of Verona
Lecturer-in-charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

The "**Industrial Plants**" module will be focused on understanding the mechanical and mechatronic behaviour of a system with the general approach underlined in the Italian S.S.D. (Settore Scientifico Disciplinare) ING-IND/13 - Meccanica Applicata alle Machine

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

2021-G. G. Muscolo-All Rights Reserved.

S.S.D. ING-IND/13: MECCANICA APPLICATA ALLE MACCHINE

«Il settore si interessa dell'attività scientifica e didattico-formativa nel campo della Meccanica Applicata alle Macchine. Il settore comprende gli aspetti culturali, scientifici e professionali inerenti lo studio dei sistemi meccanici, delle macchine e dei loro componenti e delle strutture: lo studio viene affrontato, con un approccio sistemistico unificante, mediante le metodologie proprie della ***meccanica teorica****,* ***applicata*** *e* ***sperimentale****, sfociando nell'applicazione tecnologica e* ***industriale****, con attenzione alla* ***sostenibilità ambientale ed energetica****…»*

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

2021-G. G. Muscolo-All Rights Reserved.

S.S.D. ING-IND/13: MECCANICA APPLICATA ALLE MACCHINE

«…La tipologia dei sistemi meccanici considerati è del tutto generale: macchine motrici ed operatrici, dispositivi meccanici, meccanismi, trasmissioni ed azionamenti, macchine automatiche e robot, veicoli, sistemi di trasporto e sollevamento, sistemi per la produzione di energia, sistemi biomeccanici, componenti e sistemi su scala micro/nano…»

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

2021-G. G. Muscolo-All Rights Reserved.

S.S.D. ING-IND/13: MECCANICA APPLICATA ALLE MACCHINE

*«..Sono sviluppati metodi teorici e sperimentali ed applicazioni relativi all'analisi del comportamento meccanico, alla sintesi, e alla progettazione, in particolare funzionale, delle macchine e dei sistemi meccanici, tramite lo studio della **cinematica**, della **statica**, della **dinamica**, lineare e non lineare, delle **interazioni con l'ambiente** (campi di forze, interazioni con i fluidi) e fra superfici materiali (lubrificazione), del controllo dell'**automazione** e dell'**identificazione**...»*

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

2021-G. G. Muscolo-All Rights Reserved.

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
Email: giovannigerardo.muscolo@univr.it

S.S.D. ING-IND/13: MECCANICA APPLICATA ALLE MACCHINE

«…L'implementazione tramite sistemi hardware e software analogici e digitali dei metodi sviluppati costituisce parte integrante del sapere del settore. Come ulteriore risposta a esigenze di progettazione, sviluppo e realizzazione di sistemi e componenti innovativi, sono anche studiati: i ***fenomeni vibratori****, vibroacustici e tribologici, il controllo dei sistemi meccanici,* ***la meccatronica****, le interazioni fluido-strutture, il monitoraggio,* ***la diagnostica e la prognostica di sistemi meccanici****, l'automazione a fluido e* ***la robotica****, la fluidica e la microfluidica, i sistemi ecocompatibili e le energie rinnovabili…»*

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

2021-G. G. Muscolo-All Rights Reserved.

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer-in-charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it

S.S.D. ING-IND/13: MECCANICA APPLICATA ALLE MACCHINE

«…Il settore approfondisce inoltre le problematiche inerenti i sistemi di attuazione pneumatici, idraulici, elettrici e basati su tecnologie non convenzionali (ad esempio, ***materiali intelligenti****) che ormai fanno parte integrante, insieme ai sistemi di controllo,* ***delle macchine, dei sistemi meccatronici e di molte strutture****…»*

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

2021-G. G. Muscolo-All Rights Reserved.

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
Università di Verona
Lecturer in charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021 All Rights Reserved

S.S.D. ING-IND/13: MECCANICA APPLICATA ALLE MACCHINE

«…Forti interrelazioni si attuano con le metodologie e gli algoritmi sviluppati nel settore del disegno, con i metodi dell'ingegneria industriale, della progettazione dimensionale e della costruzione delle macchine, della fluidodinamica, della bioingegneria, delle scienze motorie, della chirurgia ortopedica e protesica, delle metodologie per riabilitazione e assistenza ed infine con la interpretazione e la analisi di macchine di interesse storico.»

National Declaratory (in Italian):
http://attiministeriali.miur.it/media/265757/allegato_b.pdf

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants (ING-IND/13)
University of Verona
Lecturer-in-charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

The module will provide basic skills on **kinematics**, **statics**, and **physical interaction of components** in an industrial system.

Basic concepts of **vibrations of components** and **dynamics of industrial machines** will be studied in order to reduce disturbances and optimize the production process.

The module will analyse **mechanics of machines in industrial plants**, providing theoretical knowledge applied in concrete industrial problems.

2021-G. G. Muscolo-All Rights Reserved.

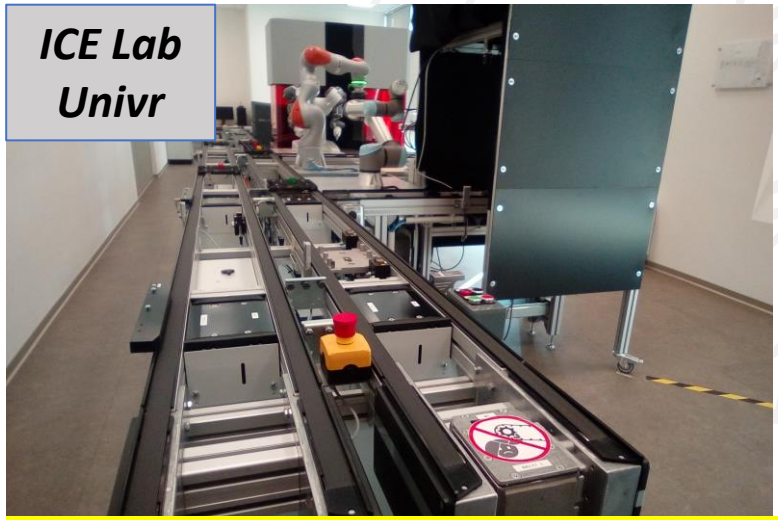
M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants (ING-IND/13)
University of Verona
Lecturer-Instructor: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

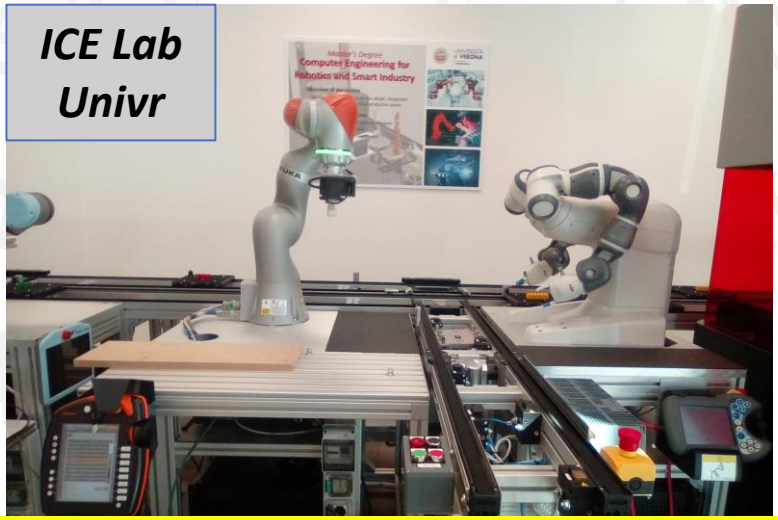
During the module, concepts of **functional industrial design** will be studied with a theoretical and applied point of view.

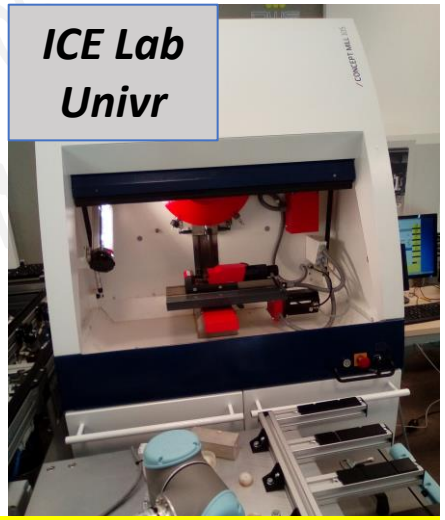
Some components of an industrial plant and their interaction will be analysed (e.g., industrial robots, exoskeletons for industry, robots with wheels/legs for industrial and agri-food plants).

2021-G. G. Muscolo-All Rights Reserved.

An interaction with the **Industrial Computer Engineering (ICE) laboratory** of University of Verona will be pursued during the module, studying some internal components of the lab, such us: industrial robots, actuators, grippers, conveyors, mechatronic systems. (link: https://www.icelab.di.univr.it/)



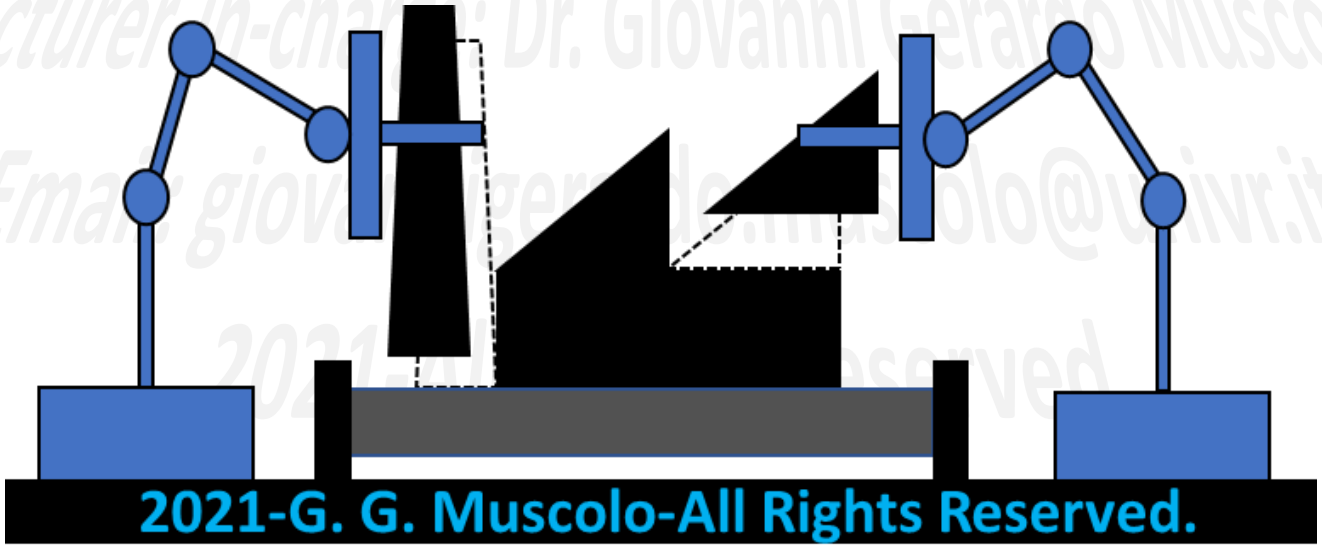




Courtesy of the ICE Lab, University of Verona (Univr), Verona, Italy (https://www.icelab.di.univr.it/)

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer in charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-G. G. Muscolo-All Rights Reserved.

Each student, **individually**, can complete an **Industrial Plant Project (IPP) (OPTIONAL)** in order to analyse an industrial problem and propose a solution.



2021-G. G. Muscolo-All Rights Reserved.

M.Sc. Computer Engineering for Robotics and Smart Industry
Course: Industrial Plants & Production Management
Module: Industrial Plants 2021-2022
University of Verona
Lecturer-in-charge: Dr. Giovanni Gerardo Muscolo
Email: giovannigerardo.muscolo@univr.it
2021-All Rights Reserved

Final Validation:

The final validation of the module is performed **answering questions and solving exercises** in a test (written or oral).

In order to pass the final validation, a score higher or equal to **18/30** must be obtained.

2021-G. G. Muscolo-All Rights Reserved.

Final Validation:

OPTIONAL: an **Industrial Plant Project (IPP)**, assigned by the teacher, can be individually completed by each student **for a bonus (up to +6 points)**.

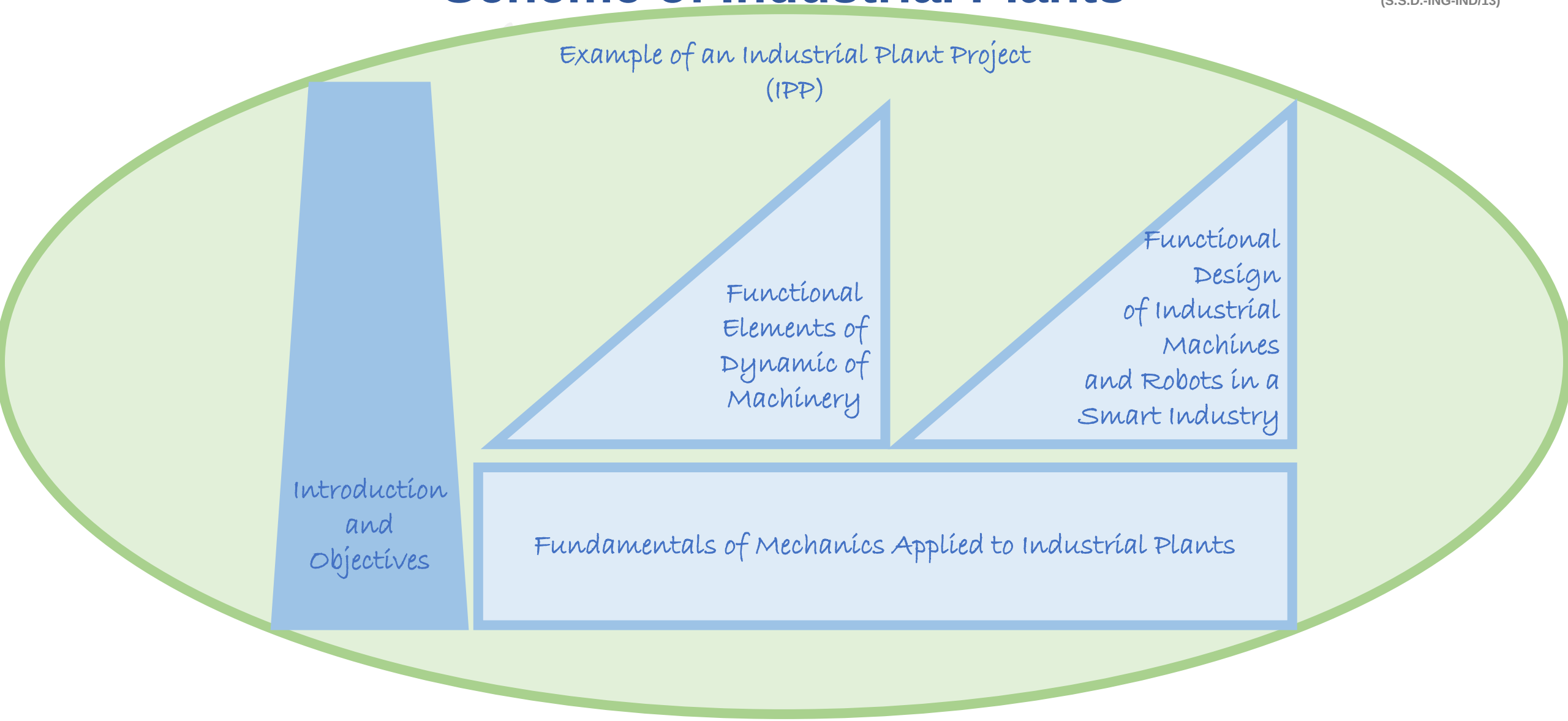
The IPP project is optional, and **it is NOT necessary for passing the final validation**.

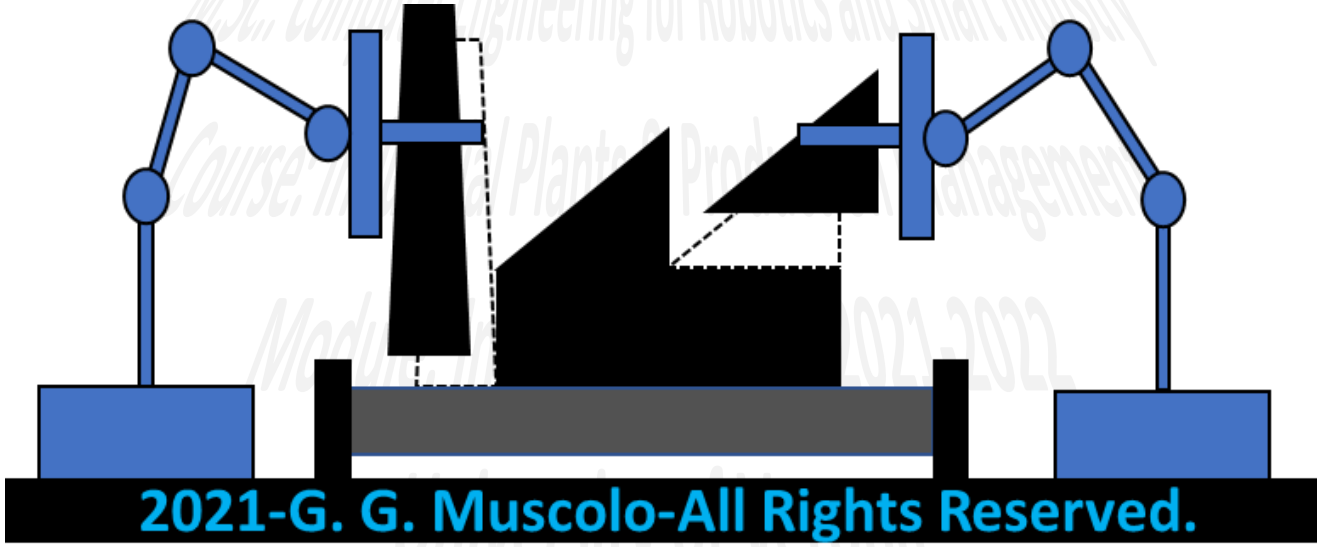
The IPP must be requested to the teacher during the module, and the final report of IPP must be sent to the teacher almost one week before the date of the test (written or oral) in which the student would like to participate.

M.Sc. Computer Engineering for Robotics and Smart Industry

2021-G. G. Muscolo-All Rights Reserved.

Scheme of Industrial Plants





Industrial Plants

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

Dr. Giovanni Gerardo Muscolo
Assistant Professor in Applied Mechanics
(S.S.D.-ING-IND/13)

2021-All Rights Reserved

Email: giovannigerardo.muscolo@univr.it