Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Digital Factory and Industrial Maintenance
Course code	47560
Scientific sector	ING-IND/17
Degree	Master in Industrial Mechanical Engineering
Semester	2nd
Year	I
Academic year	2021/22
Credits	5
Modular	Yes

Total lecturing hours	32 hrs
Total lab hours	12 hrs
Total exercise hours	-
Attendance	Extremely recommended
Prerequisites	none
Course page	https://www.unibz.it/it/faculties/sciencetechnology/master-industrial-mechanical-engineering/course-offering/?academicYear=2021

Specific educational objectives	The course belongs to the class of characterizing courses for the curricula "Logistics and Production" of the Master in Mechanical Engineering. The first part of the course (Advanced Industrial Maintenance) aims at providing students traditional and advanced concepts in maintenance for industrial plants, also considering data-driven and predictive approaches. The second part of the course (Advanced Digital Factory and Plant Planning) aims at providing the students the concepts of digital factories related to digitization and simulation of manufacturing processes, also using a dedicated software for the modeling of a case study.

Lecturer	Dr. Beatrice Marchi, beatrice.marchi@unibz.it Dr. Luca Gualtieri, luca.gualtieri@unibz.it
Scientific sector of the lecturer	ING-IND/17
Teaching language	English
Office hours	By appointment
Teaching assistant *(if any)*	-
Office hours	By appointment
List of topics covered	The course covers the following topics: **<u>Advanced Industrial Maintenance</u>** <u>Lecture</u>

	1. Introduction to maintenance in production system and refresh of basic concepts about industrial maintenance; 2. Advanced concepts of industrial maintenance for complex production systems; 3. Maintenance and risk mitigation for Industry 4.0 and data-driven decision making in industrial maintenance; 4. Introduction to condition monitoring and predictive maintenance; 5. Strategies and technologies for predictive maintenance implementation; Laboratory: 6. Numerical exercises. **Advanced Digital Factory and Plant Planning** Lecture 1. Introduction to digital factory planning and design in Industry 4.0 context; 2. Introduction to digital factory planning tools and software; 3. Understanding the virtual environment; 4. Understanding the main commands for design and simulation; 5. Understanding tools for case study evaluation and report; Laboratory 6. Introduction to the virtual environment and basic commands for design, simulation and reporting; 7. Case study modeling; 8. Case study simulation; 9. Simulation-based re-design of the case study; 10. Process evaluation and reporting;
Teaching format	Frontal lectures supplemented by exercises and case studies, exercises on the use of dedicated software.

Learning outcomes	Knowledge and understanding In the first part, the students will be able to master advanced concepts of industrial maintenance and risk management, also considering data-driven and predictive approaches, Furthermore, they will acquire basic concpets related to the use of several tools of maintenance design and management. In the second part, students will be able to master the fundamental concepts of digital factories concerning process modeling and simulation for design and evaluation purposes. Furthermore, they will acquire the basic concepts related to the use of a software for the modeling and simulation of manufacturing processes.

	Applying knowledge and understanding The students will be able to analyze reliability of complex industrial systems and to design and manage an efficient solution for the implementation of traditional and predictive maintenance strategies in industrial settings according to specific requirements. They will be also able to use Tecnomatix Process Simulate to model, simulate and evaluate simple manufacturing processes to support digital factory planning. Making judgments Students will be able to critically evaluate the appropriateness of various approaches with respect to digital factory planning, modeling, and simulation, as well as to find proper solutions to plan and manage predictive industrial maintenance. Communication skills Students will be able to use technical vocabulary related to the covered topics. Furthermore, they will be able to structure, prepare and present scientific and technical documentation describing project activities and to discuss them with decision-makers. Learning skills Students will be able to autonomously expand their knowledge acquired during the course through reading and understanding scientific and technical documentation (including that provided by lecturers). Similarly, they will be able to expand their skills related to the use of the proposed software, i.e. by using dedicated tutorials.
Assessment	Evaluation will be by written examination supplemented by a practical composition developed by the student. The written part will consist of answering theoretical questions and/or completing exercises on the topics covered in the course. The composition will be related to the exercises held on the use of the software, as well as the autonomous development of a case study by means of the notions acquired on the use of the program. The parts of the final exam are following summarized:

Form	**Duration**	**Contribution to final grade**
Written part (answering theoretical	2 hours	50%

	<table><tr><td>questions and/or completing exercises)</td><td></td><td></td></tr><tr><td>Composition related to the use of the software</td><td>To be carried out in the classroom and/or independently</td><td>50%</td></tr></table> In case a written exam cannot be held due to COVID-19 restrictions, the course responsible reserves the right to hold an oral exam instead of the written exam (eventually online).
Assessment language	English
Evaluation criteria and criteria for awarding marks	The written part of the exam will evaluate the student in consideration of the knowledge acquired on the topics covered during the course. The evaluation will also focus on the ability to find and evaluate effective solutions to practical problems. The evaluation criteria of the written part will be based on the correctness of the answers provided on the basis of technical/scientific content, language, clarity of exposition. A sufficient grade in the written part is mandatory to pass the exam (regardless of the grade given to the composition). The composition related to the use of the software will evaluate the student's ability to autonomously model, simulate, evaluate and re-design a solution for a simple manufacturing process.

Required readings	References to textbooks, lecture notes, research papers and readings may be provided by the lecturers.
Supplementary readings	1) L.Fedele, L. Furlanetto, D. Saccardi, Progettare e gestire la manutenzione, McGraw-Hill 2) R. Manzini, A. Regattieri, H. Pham, E. Ferrari, Maintenance for Industrial Systems, Springer 3) A. C. Márquez, The Maintenance Management Framework, Springer