

# Master Sciences de l'ingénieur

Programme international de Master en  
Mechatronic Systems for Rehabilitation

M1 – S2

<b>Course title</b>	<b>OTTIMIZZAZIONE E MANUTENZIONE DEGLI IMPIANTI INDUSTRIALI</b> <b>Optimization and maintenance of industrial plants</b>		<b>Code</b>	
<b>Course description</b>				
Course components: CM (lectures), TD (tutorials), TP (practical work), Projects	80 h CM + 15 h TD + 30 h TP			
European Credits	5			
Master specialization	Mechatronic Systems for Rehabilitation (MSR)			
Semester	S2			
Language	Italian			
Maximum number of students	15			
<p><b>a) Objective</b></p> <p>The course aims at teaching the main techniques and methodologies for the optimisation of the productive systems, paying attention to the relevant differences, advantages and limits of the different approaches. The last part of the course is devoted to the description of maintenance practices and to maintenance planning, giving also reference to the design of maintainable products and systems.</p> <p><b>b) Content</b></p> <p>Queuing Theory and Markov chains. Petri Nets. Advanced optimization theory. Maintenance of industrial plants and Design for Maintenance.</p> <p><b>c) Pre-requisite</b></p> <p>Basic knowledge of calculus, statistics and Operational Research. However, given the heterogeneous composition of the class, a brief summary on Statistics and Operational Research is always given.</p> <p><b>d) Evaluation methods / Knowledge acquisition control</b></p> <p>Written numerical exercise plus written examination on theory. An oral examination can be required, according to the results of the two written tests. Under given circumstances, the oral examination may substitute the written examination on theory (e.g., foreign students, convenient number of students applying to the exam).</p>				
<b>Teaching organization</b>				
University work	Total time volume	Weekly number of hours	Number of students per group	
Lectures (CM)	80 h			
Tutorials (TD)	15 h			
Practical work (TP)	30 h			
Projects	(*)			
Other				

(\*) Projects may be carried out, on a voluntary basis, to deepen the arguments taught.

<b>Course title</b>	<b>LABORATORIO DI STRUMENTAZIONE PER L'AUTOMAZIONE</b> <b>Laboratory of instrumentation for automation</b>		<b>Code</b>	
<b>Course description</b>				
Course components: CM (lectures), TD (tutorials), TP (practical work), Projects	28 h CM + 60 h TD + 40 h TP			
European Credits	3			
Master specialization	Mechatronic Systems for Rehabilitation (MSR)			
Semester	S2			
Language	Italian			
Maximum number of students	15			
<p><b>a) Objective</b></p> <p>Learn the basic knowledge of programmable components and distributed architectures at the cell level of industrial plants. Particularly, PLCs and PC-based systems for sensors and actuators management, together with fieldbus and emerging technologies in the industrial communication field, are analyzed and experimented.</p> <p><b>b) Content</b></p> <p>Devices and systems for industrial automation and process control; Programmable Logic Controller (PLC); Distributed systems: sensor/actuator networks for industry.</p> <p><b>c) Pre-requisite</b></p> <p>Fundamentals of informatics and digital electronics</p> <p><b>d) Evaluation methods / Knowledge acquisition control</b></p> <p>Written, practical (PLC programming) and oral examination. Student can choose to avoid oral examination.</p>				
<b>Teaching organization</b>				
University work	Total time volume	Weekly number of hours	Number of students per group	
Lectures (CM)	28 h			
Tutorials (TD)	60 h			
Practical work (TP)	40 h			
Projects				
Other				

<b>Course title</b>	<b>DISPOSITIVI E SISTEMI MECCANICI</b> <b>Mechanical Devices</b>		<b>Code</b>	
<b>Course description</b>				
Course components: CM (lectures), TD (tutorials), TP (practical work), Projects	50 h CM + 75 h TD			
European Credits	3			
Master specialization	Mechatronic Systems for Rehabilitation (MSR)			
Semester	S2			
Language	Italian			
Maximum number of students	15			
<p><b>a) Objective</b></p> <p>Learn how the most important mechanical transmission components work. The teaching is focused on the kinematic and dynamic behaviour of such mechanical elements.</p> <p><b>b) Content</b></p> <p>Friction drives. Gears. Gear trains. Belts. Chains. Universal joints.</p> <p><b>c) Pre-requisite</b></p> <p>None</p> <p><b>d) Evaluation methods / Knowledge acquisition control</b></p> <p>Written examination: twelve questions and exercises having seventy-five minutes at disposal.</p>				
<b>Teaching organization</b>				
University work	Total time volume	Weekly number of hours	Number of students per group	
Lectures (CM)	50 h			
Tutorials (TD)	75 h			
Practical work (TP)				
Projects				
Other				

<b>Course title</b>	<b>MODELLISTICA E SIMULAZIONE</b> <b>Modeling and simulation</b>		<b>Code</b>	
<b>Course description</b>				
Course components: CM (lectures), TD (tutorials), TP (practical work), Projects	42 h CM + 65 h TD + 18 h TP			
European Credits	3			
Master specialization	Mechatronic Systems for Rehabilitation (MSR)			
Semester	S2			
Language	Italian			
Maximum number of students	15			
<p><b>a) Objective</b></p> <p>The course is aimed at introducing students to:</p> <ul style="list-style-type: none"> <li>• mathematical modelling (e.g. systems analysis);</li> <li>• simulation methods and software;</li> <li>• decision models.</li> </ul> <p><b>b) Content</b></p> <p>Modelli descrittivi: sistemi dinamici, modelli nello spazio degli stati, analisi dei sistemi lineari e non lineari (equilibrio, stabilità), stima dei parametri (minimi quadrati). Modelli decisionali: programmazione matematica, programmazione lineare, problemi multiobiettivo.</p> <p>Descriptive models: state-space modelling, analysis of linear and nonlinear systems (equilibrium, stability), parameter estimation (least square criterion). Decision models: mathematical programming, linear programming, multiobjective.</p> <p><b>c) Pre-requisite</b></p> <p>Basic knowledge of Matrix Algebra and Mathematical Analysis.</p> <p><b>d) Evaluation methods / Knowledge acquisition control</b></p> <p>The exam is in two parts:  The first part is written form and concerns the numerical solution of simple problems and the answering of short questions.  The second part is in laboratory and requires to solve problems using Matlab and Simulink.</p>				
<b>Teaching organization</b>				
University work	Total time volume	Weekly number of hours	Number of students per group	
Lectures (CM)	42 h			
Tutorials (TD)	65 h			
Practical work (TP)	18 h			
Projects				
Other				

<b>Course title</b>	<b>MECCANICA DEI SERVOSISTEMI</b> <b>Mechanics of servo systems</b>		<b>Code</b>	
<b>Course description</b>				
Course components: CM (lectures), TD (tutorials), TP (practical work), Projects	44 h CM + 65 h TD + 16 h TP			
European Credits	3			
Master specialization	Mechatronic Systems for Rehabilitation (MSR)			
Semester	S2			
Language	Italian			
Maximum number of students	15			
<p><b>a) Objective</b></p> <p>Learn the basic concept of the structure of an automatic machines or manipulator including kinematics and dynamics model, generation of trajectories, theory of control.</p> <p><b>b) Content</b></p> <p>Kinematics and dynamics of planar manipulators. Trajectories and laws of motions. Control of electrical actuators. Control of manipulators and automatic machines. Effects of masses, elasticity, friction, backlash.</p> <p><b>c) Pre-requisite</b></p> <p>Basic knowledge of calculus, matrix algebra, physics (mechanics), bases of control theory.</p> <p><b>d) Evaluation methods / Knowledge acquisition control</b></p> <p>Written numerical exercise plus oral examination on theory.</p>				
<b>Teaching organization</b>				
University work	Total time volume	Weekly number of hours	Number of students per group	
Lectures (CM)	44 h			
Tutorials (TD)	65 h			
Practical work (TP)	16 h			
Projects	(*)			
Other				

(\*) The student can choose to develop a project that substitutes the written examination.

