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MILANO 1863

SCUOLA DI ARCHITETTURA URBANISTICA INGEGNERIA DELLE COSTRUZIONI

SCUOLA DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE

Internal Double Degree

Building and Architectural Engineering (LM-24) and Mechanical Engineering (LM-33)

1. Foreword

In recent years, engineering professions into a global economy are facing innovative challenges that emphasize the demand for modern engineering education offering more transversal skills and technical competencies. These features cannot be offered by a single conventional master degree programme.Starting from 2011 the idea of joint programmes was introduced at Politecnico di Milano and new roadmaps for joint Double Degrees (DD) have been established in order to combine complementary skills and to culturally widen the current degree programmes.

The general objective of this approach is to fully exploit synergies and complementaritiesamong different master degree study plans, to make educational offer more flexible and better matching the dynamics of the industrial world.

2. Learning objectives

The internal Double Degree in Building and Architectural and Mechanical Engineering aims at capturing the emerging challenges of the construction industry that plays a significant influential role in national and global economies. In particular, such sector is at a turning point, following the economic downturn, in the midst of a new industrial revolutionary cycle.The key principles of Industry 4.0 or fourth industrial revolution –self-directed decision-making, embedded sensor-rich networks and industrial-additive manufacturing – are at early stages in the construction sector but we are closer to a fully implementation.The degree of automation in construction is far less than in other industries, such as manufacturing. This

results in poor productivity, poor quality, risky working conditions, higher energy consumptions, higher carbon emissions. In this framework, automation and robotics applications offer great opportunities. These new challenges ask for new professionals able to integrate the typical skills of an architectural engineer with the key technical competencies of a mechanical engineer.

The mission of the Mechanical Engineering Programme is to train professionals with a solid foundational base, a good scientific method and broad technical and applicative knowledge. A mechanical engineer, being involved in the design, optimization and management of products, systems and production processes, must reach a sound preparation in design and testing methodologies, numerical simulation, manufacturing processes, automation and control, material properties and related selection criteria.

The Building and Architectural Engineering Programme prepares high-level professionals that can work in the field of the built environment, and in particular of high-energy performance, low environmental impact buildings and their components, thanks to a multi-disciplinary training and to the acquisition of specialist engineering skills.The programmegives students the ability to manage – and take part in – the integrated design process of complex construction projects through theoretical classes and applied design exercises.

The integration of the Building and Architectural Engineering and Mechanical Engineering programmes aims to train innovative professionals, with a solid industrial technical background matched with robust skills in the field of construction technologies and design processes, able to manage the challenges of the future construction industry.

3. The study plan

A total of 180 credits over three years must be gained to obtain the DD in Building and Architectural and Mechanical Engineering. Students will therefore need to select courses in excess with respect to the standard Master of Science programme (120 credits over two years). The applicants have to enrol in the M.Sc. in Building and Architectural Engineering or in the M.Sc. in Mechanical Engineering, and then present a – formally – individual study programme to extend their career for the third year.

Considering the current study plans of the individual master degree courses and the specific requirements set by the Degree Classes of the Italian Ministry of Education, it is expected

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that the students coming from one of the two individual study plans would develop a multidisciplinary graduation thesis covering topics that are typical of both the study programmes at the end of the second year and during attendance of the third year.
The overall DD study plan should be considered as a set of accurately customised tracks aimed at supplying to a Mechanical Engineer all the fundamental knowledge required for an additional master degree in Building and Architectural Engineering (MEC-BAE study plan) and to a Building and Architectural Engineer those required for an additional master degree in Mechanical Engineering (BAE-MEC study plan). These combined tracks generally adopt pre-existing courses, mainly selected among those offered by the Master degree study plans, in order to supply fundamentals about the second degree.

4. Structure of the study plan

The study plan is developed and specifically customised for Building and Architectural Engineering students (both Building Engineering and Architectural Engineering track are considered) wishing to expand their expertise in Mechanical Engineering (BAE-MEC track) and for Mechanical Engineering students with specific interests in Architectural Engineering (MEC-BAE track).
The structure of the study plan is illustrated in detail in the following table. It consists of 57-62 CFU of grounding courses (depending on the student's Bachelor degree), which are followed by a common track consisting of courses taken from both BAE(Architectural Engineering track only) and MEC MSc programmes.
Students enrolled at the first year of the Building Engineering track and admitted to the Double Degree Program, will have to transfer to the Architectural Engineering track at the second year. The third and final year has a strong focus on the development of the final thesis, where the acquired multidisciplinary skills from both Building and Architectural and Mechanical engineering are applied in practice to a joint project work.
The courses offered in the Mechanical Engineering programme and in the Architectural Engineering track take place in the Lecco campus of Politecnico di Milano.

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BAE – MEC track

The first two years of the Double Degree Programme differ for students enrolled at the first year in the Building Engineering track and the Architectural Engineering track. The third year is common.

For students enrolled in the Architectural Engineering track:

Year 1 –AE*– MEC *** Architectural Engineering track**					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
055769	ING-IND/11	Building Physics	1	12	12
055770	ICAR/09	Structural Design	1	9	9
054406	ICAR/10	Sustainable Multidisciplinary Design Process + studio	1	9	9
096612	ICAR/11	Integrated Project Management and Design Tools	1	6	6
097626	ICAR/11	Design Optioneering	1	6	12
097619	ICAR/10	Energy Efficient Buildings	2	6	
095844	ING-IND/17	Design and Management of Production Systems	2	10	10
		48 credits BAE (AE) + 10credits MEC			**58**

Year 2– AE* - MEC *** Architectural Engineering track**					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
095840	ING-IND/16	Advanced manufacturing processes	1	10	10
095837	ING-IND/13 ING-IND/32 ING-INF/04	Control and Actuating Devices for Mechanical Systems	1	9	9
055852	ING-IND/12	Measurements	1	5	5
095838	ING-IND/21	Applied Metallurgy	1	6	6
095842	ING-IND/13	Mechanical System Dynamics	2	5	5
095841	ING-IND/14	Machine Design 2	2	10	10
095839	ING-IND/09	Energy Systems LM	2	7	7
096601	ING-IND/22	Building Materials	2	9	9
		9credits BAE (AE) + 52credits MEC			**61**

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For students enrolled in the Building Engineering track:

Year 1 – BE* – MEC *** Building Engineering track**					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
053211	ING-IND/11	Advanced Building Physics	1	12	12
096560	ING-IND/22	Advanced Construction Materials	1	9	9
053289	ICAR/09	Structural Analysis	1	9	9
096562	ICAR/10	Advanced Building Envelope Components Engineering	2	9	9
053212	ING-IND/11	Building Services and Building Services Energy Modelling	2	12	12
054747	ICAR/10	Fundamentals of Integrated Building Design	2	9	9
		60 credits BAE (BE)			**60**

Year 2–BE* - MEC *** Building Engineering track**					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
095840	ING-IND/16	Advanced manufacturing processes	1	10	10
095837	ING-IND/13 ING-IND/32 ING-INF/04	Control and Actuating Devices for Mechanical Systems	1	9	9
055852	ING-IND/12	Measurements	1	5	5
095838	ING-IND/21	Applied Metallurgy	1	6	6
095842	ING-IND/13	Mechanical System Dynamics	2	5	5
095841	ING-IND/14	Machine Design 2	2	10	10
095839	ING-IND/09	Energy Systems LM	2	7	7
095844	ING-IND/17	Design and Management of Production Systems	2	10	10
		62credits MEC			**62**

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For students enrolled in both the Building Engineering and Architectural Engineering tracks:

Year 3 – BAE - MEC					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
099757	ICAR/11	Sustainable Building Technologies + studio (common project work)	1	9+3	12+6
055774	ICAR/14	Architectural Design studio (common project work)	1	6	
051583	ING-IND/13	Robotics and Mechatronics	1	8	16
051582	ING-IND/16	Advanced Manufacturing Systems	1	8	
051585	ING-IND/15	Computer-Aided Design and Mechanical Prototyping	1	8	
051584	ING-IND/14	Lightweight Design of Smart Mechanical Systems	1	8	
091506	ING-IND/12	Measuring Techniques and Sensors for Automation B	1	8	
053221	ICAR/11 ING-IND/22	Timber systems Design Construction and Sustainability	2	6	6
		Final Thesis (Integrated thesis work BAE-MEC 18 credits + 052444 Thesis preparation: horizontal competences 3 credits)	1, 2	21	21
		12 credits BAE (AE) + 22 credits MEC + 21			**61**

MEC – BAE track

Year 1– MEC-BAE					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
095840	ING-IND/16	Advanced manufacturing processes	1	10	10
095837	ING-IND/13 ING-IND/32 ING-INF/04	Control and Actuating Devices for Mechanical Systems	1	9	9
055852	ING-IND/12	Measurements	2	5	5
095838	ING-IND/21	Applied Metallurgy	1	6	6
095842	ING-IND/13	Mechanical System Dynamics	2	5	5
095841	ING-IND/14	Machine Design 2	2	10	10
095839	ING-IND/09	Energy Systems LM	2	7	7
096601	ING-IND/22	Building Materials	2	9	9
		9credits BAE (AE) + 52credits MEC			**61**

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Year 2– MEC-BAE					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
055769	ING-IND/11	Building Physics	1	12	12
055770	ICAR/09	Structural Design	1	9	9
054406	ICAR/10	Sustainable Multidisciplinary Design Process studio	1	9	9
096612	ICAR/11	Integrated Project Management and Design Tools	1	6	6
097626	ICAR/11	Design Optioneering	1	6	12
097619	ICAR/10	Energy Efficient Buildings	2	6	
095844	ING-IND/17	Design and Management of Production Systems	2	10	10
		48credits BAE (AE) + 10 credits MEC			**58**

Year 3 – MEC - BAE					
Code	**SSD**	**Course title**	**Semester**	**Credits**	**Credits**
099757	ICAR/11	Sustainable Building Technologies + studio (common project work)	1	9+3	12+6
055774	ICAR/14	Architectural Design studio (common project work)	1	6	
051583	ING-IND/13	Robotics and Mechatronics	1	8	16
051582	ING-IND/16	Advanced Manufacturing Systems	1	8	
051585	ING-IND/15	Computer-Aided Design and Mechanical Prototyping	1	8	
051584	ING-IND/14	Lightweight Design of Smart Mechanical Systems	1	8	
091506	ING-IND/12	Measuring Techniques and Sensors for Automation B	1	8	
053221	ICAR/11 ING-IND/22	Timber systems Design Construction and Sustainability	2	6	6
		Final Thesis (Integrated thesis work BAE-MEC 18 credits + 052444 Thesis preparation: horizontal competences 3 credits)	1, 2	21	21
		18 credits BAE (AE) + 22 credits MEC + 21			**61**

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5. Admissions

Applications for the Internal Double Master of Science degree may be submitted by students of the Politecnico di Milano enrolled in the Master Programmes in Building and Architectural Engineeringand Mechanical Engineering. This call is issued once a year.

An evaluation Committee will select the applicants. It will be composed both by professors from the Study course in Building and Architectural Engineering and Mechanical Engineering as selected by the respective Schools.

Only students successfully selected can take part in the Double Degree programme and the related initiatives. Information about the call and its results will be published on the following websites:

http://www.ccsmecc.polimi.it/

http://www.ingindinf.polimi.it/didattica/doppie-lauree-interne/

http://www.ccsbae.polimi.it/

http://www.auic.polimi.it/en/educational-offer/double-degrees/internal-double-degrees/

6. Contacts

Contacts for M.Sc. in Architectural Engineering:

- Prof. Gabriele Masera (gabriele.masera@polimi.it)
- Prof. Giuliana Iannaccone (giuliana.iannaccone@polimi.it)

Contacts for M.Sc. in Mechanical Engineering:

- Prof. Gaetano Cascini (gaetano.cascini@polimi.it)
- Prof. Francesco Braghin (francesco.braghin@polimi.it)