DOCTORAL SCHOOL IN
Industrial Innovation Engineering

REGULATIONS OF THE STUDIES
10 April 2014

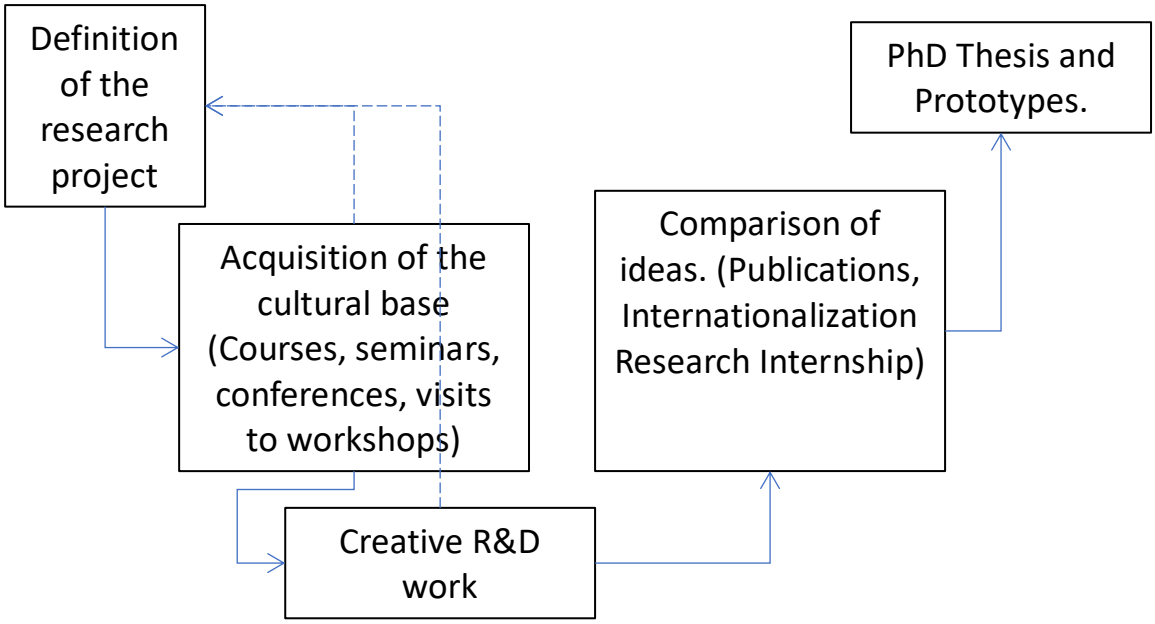
The Doctoral School in Industrial Innovation Engineering (I3) provides teaching and research training activities, with a training course spread over a three-year period. It is divided into two curricula: a curriculum in "**Engineering Management" and** a curriculum in "**Mechatronics and Energetic Engineering**".

Summary

1. Training

The training model provides a path that starts from the definition of the research project within which the PhD student will carry out the activity, to pass through a specialized training activity on the chosen topic, and then to transit in a creative phase and then to verify the ideas developed in an international context, through the presentation of original scientific works and study internships at institutions of international value. The course ends with the writing of the doctoral thesis and (if any) the development of prototypes.

The course of study is schematized in the following figure:



In consideration of the fact that scientific research is by its nature susceptible to rethinking and modification in the course of the work, it is possible to review and reshape the research objectives initially specified in a motivated manner and consistent with the instances highlighted by the bibliographic research and the development of the first ideas. In the diagram above, this is schematized by the presence of the dotted paths, which imply a review of the initial steps following changes in the objectives of the research in progress.

2. Curricula

The Doctoral School in Industrial Innovation Engineering (I3) includes two different cultural strands, developed in two different curricula, one related to **Management Engineering** and one related to **Mechatronic and Energy Engineering**, united by a strong orientation towards innovation.

The Curriculum in **Management Engineering** refers to the integration processes of complex systems in their technical and managerial dimensions. The causes of the need for integration are many: the increased technological complexity of products and services; globalization and the phenomena of delocalization and outsourcing; the emergence of new forms of network organization. The consequences on the production level are shorter product life cycles, integrated supplier management, progressive reduction of production batches, and the need for more complex management and monitoring systems. The scientific issues addressed are therefore related to the design of flexible production systems and intra- and inter-organizational processes; resource and production planning; logistics and distribution; organizational control; knowledge management; business networks; management of information flows through new ICT technologies.

The Curriculum **in Mechatronic and Energy Engineering** refers to research topics in the field of innovative mechatronic devices and systems with a high degree of integration and in the context of the processes and technologies resulting from the generation, transmission and use of different forms of energy. Basic and applied research for the integration of frontier technologies in mechatronic systems and devices and the development of technologies for high-efficiency thermodynamic systems of the First and Second Principles are crucial elements in the international scientific context, with important repercussions on the economic fabric, including local ones. Specifically, the scientific topics addressed are related to the development of intelligent mechatronic materials, hydraulics, the development of

industrial electronic systems and devices, the control and optimization of robotic and manufacturing systems, the optimization of generation, transmission, and conversion and use processes of different forms of energy starting from renewable ones, the analysis and monitoring of environmental impact, the development of sensor networks, the impact of human factors in product design.

The educational offer and research opportunities are aimed at the acquisition of the skills required not only for research and development activities in universities, public and private research centers and industry, but also to formalize and increase the managerial skills of doctoral students in the field of research and technological development.

The Doctoral School in I3 aims to train qualified researchers in the areas of Industrial Information Engineering, with transversal and integrated skills (CUN area 09, Industrial and Information Engineering and 08, Civil Engineering and Architecture), who find themselves with excellent employment prospects in the research and development offices of the modern manufacturing and service industry.

3. Teaching and research training activities

The Doctoral School in III provides teaching and research training activities, with a training course spread over a three-year period. This course involves a total study commitment that can be assessed in **180 Doctoral Credits (CFD)** and ends with the presentation of the Doctoral thesis. The activities planned within the School can be classified as follows.

3.a) Didactic activities

Teaching activities are organized and coordinated by the School Council and take place mainly at the Faculty of Engineering of Reggio Emilia and the research laboratories of the Department of Engineering Sciences and Methods of Reggio Emilia (DISMI) or other departments of the University.

Among the activities offered to PhD students there are some courses, offered with frontal teaching, which **involve a total commitment of at least 42 CFDs**, held mainly in English, on leading topics of Industrial, Information and Civil Engineering. These courses will be offered mainly in the first year (at least **22 CFDs) and in the second year (at least 12 CFDs**); **the third year, on the other hand, is entirely dedicated to research activities and thesis writing.**

3.b) Research training activities.

In the context of the research training of each PhD student, a fundamental role is played by the orientation action carried out by the relative tutor. This activity must be aimed at involving PhD students in large-scale projects, fostered by national and international collaborations, and in research contracts with institutions or industries. In this context, the possibility of carrying out short or long-term training periods at foreign companies and/or operating in the various districts in our territory, or at national or international research centers, is particularly important.

The I3 School aims to train researchers capable of integrating basic research with applied research, also aimed at industrial technology transfer. The research topics are, therefore, both theoretical and applicative. Therefore, PhD theses must not only cover theoretical aspects, but also illustrate the relevance of the results acquired in terms of technological innovation. To achieve this result, it is believed that it is qualifying to carry out a collaboration activity with companies particularly oriented to industrial research, thus favoring the applicative relevance of the results. It is up to the University, on the other hand, to verify the innovativeness and scientific rigor of the work carried out. The School, however, in order to develop methodologies with a broad scientific spectrum, also promotes PhD theses in research not necessarily carried out in collaboration with companies.

The credits that can be acquired through the research activity concern both theoretical studies and experiments carried out as part of the activities envisaged in the two Doctoral Curricula. **Each student's research activity is submitted to the School Council at the end of each year of study for approval.**

4. Typology of didactic activities.

The school's teaching activity in I3 includes the three types of courses illustrated below.

4.a) Courses of the I3 Doctoral School (ISD)

The Doctoral School in I3 organizes specific courses for PhD students with the aim of providing advanced knowledge in various sectors of Industrial, Information and Civil engineering, and their integration.
The *courses of the Doctoral School in* I3 may be of general interest, and, having a transversal character, are eminently oriented towards training; alternatively, they may concern more specific topics, such as, for example, the research topics mentioned above for the two Curricula. These courses can be provided both by professors belonging to the Doctoral School and/or the University of Modena and Reggio Emilia and by external professors (Italian or foreign).
Each of the courses of the Doctoral School in I3 **allows you to acquire at least 3 CFDs** after passing a final exam to be taken immediately of the course itself. The law of correspondence applies, which attributes 1 CFD to 3-5 hours of lectures. The definition of the number of CFDs associated with each hour of teaching depends on the type of course and **will be communicated, at the same time as the programs and examination methods, in the School's Educational Offer**.

4.b) Other courses (AID)

These are university courses not organized directly by the Doctoral School. They allow students to acquire advanced knowledge in the scientific sectors of interest to the School.
External teachings include
1) advanced courses included in the educational offer of the Master's and Master's degree courses of the University of Modena and Reggio Emilia,
2) advanced courses included in the educational offer of master's degree courses and second-level master's degree courses of other Italian or foreign universities,
3) courses of other schools/doctoral courses of the University of Modena and Reggio Emilia or of other Italian or foreign universities.
4) A student can attend *seminars* and *short courses* of a minimum duration of 2 hours each, available at
- Italian or foreign research centres,
- national or international conferences (tutorials, plenary, short course).
5) A student can attend
- summer schools in Italy or abroad,
-workshop
- national or international conferences

Seminars*, short courses*, summer schools, workshops and conferences are subject to the correspondence law which associates 2-4 hours with 1 CFD, if approved by the School Council. For each seminar or short course, the tutor or the Lecturer of the School Council who promoted it must submit a short report accompanied by a proposal for the attribution of CFDs.

The recognition of *external courses* requires prior approval by the School Council. External courses must include a final exam. The student who has benefited from it is also required to prepare a report on the content of the course.
External *courses of* type 1) and 2) are assigned a number of CFDs equal to the number of credits of the course.
Type *3) external courses* are evaluated according to the correspondence law which attributes 1 CFD to 3-5 hours of frontal teaching.

The maximum number of CFDs that can be acquired in each category is defined in the table below

Category of educational activity		Maximum on the category	
		%	CFD
At	PhD Courses (3)	100%	42
B	Master's/Master's Degree Courses (1,2)	70%	29
C	Seminars / Tutorials / Plenary (4)	40%	16
D	Workshops/ Training schools / Congresses (5)	70%	29

4.c) In-depth study of related secondary issues (ASE)

A student, in agreement with his/her Tutor, may propose to the Academic Board one or more secondary topics to be explored under the guidance of the tutor. The aim of these activities will be to stimulate self-learning skills and the multidisciplinary nature of the training course.

5. Teaching and research activities in the three-year period.

5.a) General constraints

Students of the Doctoral School acquire at least 180 CFDs in the three-year period, 60 CFDs for each year of the course, through teaching and research activities and the writing of the doctoral thesis. In more detail, students acquire

- at least 105 CFDs from research activities,
- at least 42 CFDs from educational activities,
- 15 CFDs for the writing of the doctoral thesis.

Credits from research activities concern not only theoretical studies and experiments carried out as part of the activities envisaged in the two PhD Curricula, but also any periods of study abroad. These credits are acquired at the end of each year following the evaluation by the School Council of the annual report on the scientific activity carried out and any publications and the autonomous judgment proposed by the Tutor.

Credits from teaching activities are acquired through the teaching activities referred to in point 4, i.e. *courses of the Doctoral School (ISD)* and *other external courses (AID).*

5.b) Standard Educational Path

The *standard educational path* is the path strongly recommended by the School Council. If met, it allows, at the end of the first and second year, admission without debt to the following year. The *standard training course* is structured as follows:

First year (the total must be at least 60 CFDs)
Students acquire at least 22 CFDs through didactic activities
Students also acquire at least 25 CFDs through research activities.

II year (the total must be at least 60 CFDs)
Students acquire at least an overall of 42 (including first and second year) CFDs through didactic activities.
Students also acquire at least 35 CFDs from research activities.

III year (the total must be at least 60 CFDs)

Students acquire at least 45 CFDs from research activities and 15 CFDs through the writing of the doctoral thesis.

5.c) Individual study plan

Within three months from the beginning of the first year*, students belonging to the following categories can submit a reasoned request for an individual study plan: students enrolled in doctorates in co-tutorship, students who do not have a master's degree (or equivalent qualification) in the field of information* or industrial engineering, foreign students, students who carry out a significant part of their course at a company or research laboratory. The request is endorsed by the tutor.

The *individual study plan* includes at least 180 CFDs of activities in compliance with the general constraints referred to in point 5.a).

5.d) Admission to the following years and to the final exam.

Both for students who follow the standard educational path and for those who have been approved an individual study plan, the following rules apply for admission to subsequent years and to the final exam.

Are *Allowed* in the second year of the Doctoral School, students who, at the end of the first year,
- have received the approval of the School Council on the activities carried out in the first year, and
- have acquired at least 40 CFDs, including at least 22 CFDs from teaching activities.

Any *deviation from the framework of activities planned for the first year in the* standard educational path referred to in point 5.b is considered to be an educational debt to *be filled during the second year*, or, for students who have been approved an individual study plan referred to in point 5.c, any deviation in default with respect to what is provided for in this study plan.

Admission to the third year of the Doctoral School is open to students who, at the end of the second year,
- have received the approval of the School Council on the activities carried out in the second year, and
- have acquired at least 100 CFDs, including at least 30 CFDs from teaching activities.
- have accepted at least one communication at an international conference or an article in a journal catalogued by the *Institute for Scientific Information* (ISI)

Any deviation from the overall range of activities planned for the first and second *year in the standard training course* referred to in point 5.b is considered to be an *educational debt* to be filled during the third year, or, for students who have been approved an individual study plan referred to in point 5.c, any deviation from what is provided for in this study plan.

Students are admitted to the final exam if, at the end of the third year,
- have received approval from the School Council on the activities carried out in the third year, and
- have acquired at least 180 CFDs in accordance with the general constraints set out in point 5.a.
- have accepted at least three papers at an international conference or an article in a journal catalogued by the *Institute for Scientific Information* (ISI)

5.e) Final Examination

The student must complete the writing of the doctoral thesis within the deadline set, year by year, by the School Council. Each student's thesis must be written in English and reviewed by the relevant tutor and by any external co-tutor, proposed by the tutor himself. The choice of the co-tutor must be approved by the School Council at the beginning of the third year. The presentation of the results of the doctoral work will be organized by the School Council in the form of a final seminar. At the end of the seminar, the

Council will formulate a final judgment**. The final exam includes a commission made up of at least two external professors.**

In the event of non-admission of the student to one year of the course, the final exam is automatically postponed to the ordinary session following the one scheduled for the regular course of study. Failure to admit students to two years, even if not consecutively, automatically results in the exclusion of the student from the School.

Approved by the Academic Board on 23/03/2011