Polytechnic School - Department of Civil, Chemical and Environmental Engineering (DICCA)
Master's degree in Engineering for Building Retrofitting
Class LM-24 DEGREE REGULATION

General part

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Art. 1 Premise and area of competence

This Regulation, in accordance with the Statute and the University Degree regulation (general part and special part), discipline the organizational aspects of the teaching activity of the Master's degree course in "Engineering for Building Retrofitting", as well as any other subject devolved to it by other legislative and regulatory sources.

The Degree regulation of the Master's degree Course in "Engineering for Building Retrofitting" is resolved, pursuant to article 25, paragraphs 1 and 4 of the University Degree regulation, general part, by the Degree Program Board (DPB) of Engineering for Building Retrofitting and submitted for the approval of the Board of DICCA, after consultation with the Polytechnic School, with the prior favorable opinion of the Joint Committee of the School.

The resolutions of the DPB can also be taken in telematic mode according to the above-mentioned regulations and, in particular, of Article 14 "meetings with telematic mode" of the current General Regulation of the University (in force since 19/12/2018).

Art. 2 Admission requirements and procedures for verifying individual background

Admission to the Master's degree course in Engineering for Building Retrofitting is subject to the possession of specific curriculum requirements and adequate personal background.

All the following curricular requirements, without exception, are required before the enrolment:

- possession of a three-year degree, obtained in Italy, in one of the following classes: Civil and Environmental Engineering (L-7 DM 270/2004, 08 DM 509/1999), Building Sciences and Techniques (L-23 DM 270/2004), Architectural Sciences (L-17 DM 270/2004), Architectural and Building

Engineering (04 DM 509/1999), Industrial Engineering (L-9 DM 270/2004, 10 DM 509/1999); alternatively, Master's Degree in the following Classes: Civil Engineering (LM-23 DM 270/2004, 28/S DM 509/1999), Safety Engineering (LM26 DM 270/2004), Architecture and Building and Architecture Engineering (LM-4 DM 270/2004, 4/S DM 509/1999), Mechanical Engineering (LM-33 DM 270/2004, 36/S DM 509/1999), Environmental and Territorial Engineering (LM-35 DM 270/2004, 38/S DM 509/1999); alternatively, possession of another qualification obtained abroad and recognised as suitable;

- possession of specific numbers of ECTS obtained in sets of disciplinary-scientific sectors (SSD), characterising two of the fundamental learning areas:
    - Structural area (ICAR07, ICAR08, ICAR09): minimum 15 ECTS, of which at least 4 ECTS in ICAR07 and 6 ECTS in ICAR09;
    - building physics area (INGIND10, INGIND11): minimum 8 ECTS;

- ability to use the English language fluently, in written and oral form, with reference also to disciplinary lexicons (level B2).

The admission to the Master's degree Course is automatic for those who have obtained an Italian Bachelor's Degree with a final grade of at least 92/110 or equivalent.
For those who do have obtained an Italian Bachelor's Degree with a final grade lower than 92/110 and for those who have obtained a qualification abroad, the admission is conditioned to an evaluation of the candidate based on his/her academic qualification, training activities, CV, and eventually an oral interview.

For extra-UE students, the knowledge of the English language is verified through the presentation of a certificate at a level not lower than B2 or equivalent scale. Only the following certificates are admitted:

- Cambridge;
- Trinity;
- IELTS;
- TOEFL iBT;
- IGCSE;
- The PeopleCert Group
- Oxford Test of English;
- Linguaskill.

Both EU students and extra-UE students who do not have a B2 level or higher certification or attestation, the good knowledge of English can be also verified through online tests organised by the Language Skills Development Sector of the University of Genoa.

Art. 3 Training activities

The list of teaching units and other possible training activities, in the cohort 2022-2023, is given in the appropriate annex (Annex 1) which constitutes an integral part of this regulation. A responsible professor is identified for each teaching unit.
A professor is responsible for teaching whoever is in charge of teaching according to the law, i.e. the one to whom the relative Department Board has attributed the responsibility itself when assigning teaching tasks to professors.
The language used to provide training activities (lessons, exercises, workshops) shall be English, as indicated in the Annex (ALL.1) to this Regulation.

Art. 4 Enrolment in individual training activities

In accordance with Article 5 of the University Regulations for students, in order to enroll in individual training activities, you must have a qualification which allows access to the university.

Art. 5 Curricula

The Master's degree Course in Engineering for Building Retrofitting is not structured in curricula.

Art. 6 Total time commitment

The definition of the hourly fraction dedicated to lessons or equivalent teaching activities is established, for each teaching unit, by the DPB at the same time as defining the Degree Programme Table. In any case, we assume the following interval of variability between classroom hours/trainingcredits (ECTS) equal to: 8 ÷ 10, understanding by "classroom hours" the hours of lesson or assisted teaching activity.

The definition of the assumed total time commitment, reserved for personal study or other training activities of an individual type, is established, for each teaching unit, in the annex (Annex 1) to this regulation.

The director of DICCA Department and the coordinator of the DPB shall be responsible for verifying compliance with the above provisions.

Art. 7 Study plans and prerequisites

Students can enrol full-time or part-time; for the two types of student there are different rights and duties. The student chooses the type of enrolment when presenting the study plan. The full-time student carries out his/her training activity considering the study plan defined by the Master's degree course, which is published in the Degree Programme Table. The study plan formulated by the student must contain an indication of the training activities and the ECTS that he/she intends to achieve, provided for by the official study plan for the didactic period, up to a maximum of 65 ECTS each year.

The part-time student is required to submit an individual study plan, specifying the number of ECTS he/she intends to achieve in accordance with the University's regulations on student contributions.

The enrolment of full-time and part-time students is regulated by the University Regulations for students considering the operational provisions resolved by the central government bodies and indicated in the Student Guide (published annually on the University's website).

The training path of the student is organised according with criteria of propaedeuticity. Therefore, the study plan is strongly recommended in coherence with the educational path.

The DPB may, with a reasoned resolution, authorise students who have demonstrated particularly high academic performance in the previous academic year to include in their study plan more than 65 ECTS, but in any case, not more than 75.

"Particularly high performance" means that the student has passed all the exams of his/her study plan by the month of September.

The study plan which has a shorter duration than the normal one is approved by the Degree Programme Board.

The method and deadline for the presentation of the study plan are established annually by the Polytechnic School and reported on the website of the degree program on the student's page.

The student may enter in his/her study plan free extra-curricular teaching units up to a maximum of 12 ECTS.

Art. 8 Attendance and methods of carrying out teaching activities

The teaching units may take the form of: a) lectures, including distance learning by telematic means; b) practical exercises; c) laboratory exercises; d) thematic seminars.

The articulated profile and the demanding nature of the lessons taught as part of the course of study make the attendance to the training activities strongly recommended for an adequate understanding of the topics and therefore for a good success in the exams.

The schedule of classes is divided into semesters. As a rule, the semester is divided into at least 12 weeks of lesson plus at least 4 weeks overall for verification tests and profit exams.

The period for profit exams ends with the beginning of the lessons of the following semester.

The lesson schedule for the entire academic year is published on the Course of Study's website before the start of the lessons of the academic year. The schedule of classes guarantees the possibility of attendance based on the years of the course programme provided for by the current Degree Programme Table. For practical reasons, the compatibility of the timetable for all formally possible optional teaching choices is not guaranteed. Students must then formulate their study plan taking into account the time of the lessons. From the second year onwards, the internship envisaged in the training programme may be carried out in DICCA laboratories, other universities, research centres, companies, public bodies, etc. In the case of mobility programmes for examinations or thesis abroad, the internship may also be offered in the foreign location where the programme is carried out.

Art. 9 Examinations and other profit exams

Profit exams can be carried out in written, oral, or written and oral, according to the methods indicated in the sheets of each teaching unit published on the University website or on website of the Master's degree course. On request, specific learning verification arrangements may be provided to take into account the needs of disabled students and students with specific learning disorders (D. S. A.), in accordance with art. 20 paragraph 4 of the University Degree Regulation.

The language used for the profit examinations is English.

In the case of teaching units structured in modules with several professors, they participate collegially in the overall evaluation of the student's profit which cannot, however, be split into separate evaluations on the individual modules.

The calendar of profit exams is established by the ministerial deadline for the following academic year and is published on the University website or on the website of the Master's degree course. The calendar of any intermediate verification tests is established by the DPB and communicated to the students at the beginning of each teaching cycle.

Examinations are held in periods of interruption of classes. Examinations may be planned during the period of the classes only for students who, in the current academic year, have not included training activities in their study plan.

All profit examinations of training activities must be passed by the student by the deadline set by the student secretariat of the Polytechnic School in view of the final examination, as indicated in the "reminder" published on the University website and accessible from the School's website.

The result of the examination, with the vote obtained, is verbalized in accordance with art. 29 of the University Degree Regulation.

The profit examination Committees are appointed by the course coordinator and consist of at least 3 members, two of whom are full members, one of whom is the professor responsible for teaching. If the percentage of success for teaching is less than 30% consecutively for two academic years, the Committee will be composed of at least 5 professors and the report must certify the effective presence of at least 3 members. They may be members of the Committee who are experts in the subject identified by the course board on the basis of criteria that ensure the possession of scientific, didactic or professional requisites; these requisites may be presumed to be possessed by retired university professors. The Committees are chaired by the professor responsible for teaching and a deputy must be identified for each one.

Art. 10 Recognition of credits

The Board Degree Programme decides on the approval of applications for change or transfer from another degree course of the university or other universities in accordance with the rules provided forin the University Degree regulation, art. 18. The DPB also decides the recognition, as training credits, for a maximum number of 12 ECTS, of professional knowledge and skills certified in accordance with the

current legislation.
The evaluation of applications for change will take into account the didactic specificities and the actuality of the educational content of the individual exams taken, reserving to establish from time totime any forms of verification and supplementary exams.

Art. 11 Mobility, studies abroad, international exchanges

The DPB strongly supports the student mobility, in particular through participation to mobility and international exchange programmes. The DPB shall ensure, in accordance with the rules in force, the recognition of the training credits obtained within these programmes and shall organise the training activities as appropriate in such a way as to make these activities easier and effective.

The DPB recognizes enrolled students, who have regularly completed a period of study abroad, the exams taken off-site and the achievement of the related credits with which the student intends to replace the exams of his own study plan.

For the purposes of the recognition of these examinations, the student at the time of the compilation of the plan of training activities, he intends to follow at the University abroad, must produce suitable documentation proving the equivalence of content between the teaching unit abroad and the teaching unit that intends to replace taught in the Master's degree Course in Engineering for Building Retrofitting. Equivalence shall be evaluated by the DPB. The conversion of marks will take place according to criteria approved by the DPB, in accordance with the European ECTS system.

In the case of periods of study abroad for the preparation of the final examination, the number of credits recognised for this activity is established in relation to the duration of the period spent abroad.

Art. 12 Procedures for the final examination

The final examination consists in the discussion of a written thesis, aimed at ascertaining the candidate's technical-scientific and professional preparation.
For the purposes of obtaining a Master's Degree, the final examination consists of the writing of a theoretical, experimental or applicative thesis, elaborated by the student in an original way under the guidance of one or more supervisors, on subjects defined as relevant to a discipline for which the candidate has passed the exam. The thesis must in any case be coherent with the arguments discussed during the Master's degree.
At least one DPB lecturer must be present among the supervisors.
The thesis must be written in English; the writing of an extensive summary in Italian may be required by the DPB through the supervisor.
If a language other than English is used, the authorisation of the CCS is required, as well as a translation of the title and an extensive English summary.

The thesis must reveal the student's ability to deal with research and/or application issues. The thesis must consist of a project and/or the development of an application that proposes innovative solutions with respect to the state of the art.

The thesis must also reveal:

- preparation in the disciplines characterising the Master's Degree,
- a correct use of sources and bibliography,
- systematic and argumentative skills,
- clarity in the exposition,

- design and experimental skills,
- critical thinking skills.

The effort required of the student for the preparation of the final examination is commensurate with the number of credits allocated to the examination.
The Committee for the final examination is composed of at least five members, the majority of whommust be tenured professors and researchers and it is appointed by the Director of the DICCA Department.
The procedure for the final examination consists of the oral presentation of the thesis by the student to the Final Examination Committee, followed by a discussion of any questions raised by the members of the Committee.

If the student passes the final examination, the Committee assesses the final examination by attributing an increase, varying from 0 to 6 (maximum established by the School in agreement with the Departments and indicated in the Degree Programme Table), to the weighted average of the marks obtained in the examination tests relating to the educational activities that require a final mark, taking as a weight the number of credits associated with the individual educational activity.
Among the aspects that contribute to the definition of the mark attributed to the final examination, the Committee shall take particular account of
- quality, completeness and originality of the paper (up to a maximum of 3 points);
- presentation of the paper (up to a maximum of 1 point);
- evaluation of the student's career (duration of the candidate's studies, marks with honours, any period spent abroad for the writing of the paper or a substantial part of it) up to a maximum of 2 points.

Honours are awarded, subject to the unanimous approval of the Committee, to students who have obtained a final mark of at least 110 points. The dignity of printing for the master's thesis may be requested by the supervisor from the members of the Degree Committee at least 15 days before the graduation session, explaining the reasons. The dignity of printing is awarded by unanimous vote of the Graduation Committee.

Art. 13 Guidance services and tutoring

The Polytechnic School, in agreement with the DICCA Department, organises and manages a guidance and support service for students, in order to promote the different second-level training pathways.
The course of study identifies two tutors to support the students enrolled in the course.

Art. 14 Verification of obsolescence of credits

Credits acquired within the framework of the Master's degree course in Engineering for Building Retrofitting are valid for 6 years. If the DPB recognizes the obsolescence of even a single part of the relative educational content, the DPB itself establishes the supplementary tests that must be taken by the student, defining the topic, the methods of verification and the composition of the examination committee.

Once the required tests have been passed, the DPB validates the credits acquired with a resolution. If the related training activity provides for a vote, it may be varied from the one previously obtained, on a proposal from the Examination Committee which carried out the verification.

Art. 15 Degree Programme Table

The DICCA Department, after consulting the Polytechnic School, approves and publishes annually the Degree Programme Table. In the Degree Programme Table are indicated the main provisions of the didactic system and the degree regulation of the Master's degree course, to which additional information

may be added.

The Degree Programme Table of the Master's degree course contains the list of the teaching units activated for the academic year in question. Individual teaching units' sheets are published on the University website or on the website of the degree course.

Annex 1 to the Degree Regulation of the Master' s Degree course in Engineering for building retrofitting

List of training activities and related training objectives

First year (2022/2023)

Code	Teaching unit EN	SSD	ECTS	Type/Area	Training objectives	Hours for assisted teaching activities	Hours for personal study
97209	DIGITAL SURVEY OF BUILDINGS	ICAR/17	5	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	The course aims to teach the most recent technologies in the field of architectural survey today, both as regards the primary moment of the survey that is the phase of acquisition of the metric data, both as regards the representation and the study of objects of architectural, artistic and archaeological interest.	50	75
98114	BUILDING ECONOMICS AND EVALUATION OF PROJECTS		8				
	109204 - BUILDING ECONOMICS	ICAR/22	4	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	The course on Buildings Economics provides the basics elements on cost-benefit analysis and knowledge on methodologies for the valuation of investment projects. Attention is dedicated to net present value, internal rate of return, payback period and profitability index so to take into account cash flows (costs and revenues) over time as well as techniques for the management of risk and uncertainty with applications to case studies for the valuation of real-estate construction, renovation, investment and management.	40	60
	98113 - ECONOMIC EVALUATION OF PROJECTS	ICAR/22	4	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	The course deals with the theoretical and operational tools related to the economic and financial sustainability assessment of interventions on built heritage at the construction and urban scale.	40	60
98111	STRUCTURAL AND GEOTECHNICAL ASSESSMENT OF EXISTING BUILDINGS		11				

	97204 - STRUCTURAL ASSESSMENT AND SAFETY OF EXISTING BUILDINGS	ICAR/09	6	CORE LEARNING ACTIVITY Building industry and enviroment	The course deals with the safety assessment of existing buildings. Differently from the perspective of design of new constructions, the behavior of the structure is unknown at the beginning of the analysis requiring effective procedures to face the problem of such incomplete knowledge that involves both aleatory and epistemic (e.g. related to the effectiveness of structural details) uncertainties. The course faces both issues related, on the one hand, to the diagnosis to ordinary actions and, on the other, to the prevention against rare events. The wide variety of behaviors that characterize no standardized existing buildings makes more conventional the use of methods of analysis quite common in the design of new structures, such as the linear ones. For this reason, the course devotes large attention to the nonlinear static procedures. Finally, among rare actions, since existing buildings have been often conceived without specific rules for the seismic action, such vulnerability constitutes one of most relevant which the course focuses to, with particular attention to both masonry and reinforced concrete structures.	60	90
	97205 - GEOTECHNICAL PROBLEMS IN BUILT ENVIRONMENT	ICAR/07	5	CORE LEARNING ACTIVITY Building industry and enviroment	The aim of the course is to analyze some of the main aspects related to soil-structure interaction phenomena that occur in the built environment. Since the focus is on existing buildings, after a first part that deals with the types of foundation and the basic methods used in practice for settlement assessment and bearing capacity calculation, the issues of greatest interest, due to external and natural causes (e.g. slope movements, soil liquefaction, groundwater oscillations, subsidence, etc.) and anthropogenic (e .g. deep excavations, shallow tunnels, etc.), are detailed and studied in depth. The course also provides the knowledge and skills to students on design and intervention guidelines relating to the foundation-soil system, such as the strengthening of foundations, underpinnig and soil improvement.	50	75
98108	CONSTRUCTION TECHNIQUES, DAMAGE AND DETERIORATION OF BUILDINGS		10		The course aims to introduce the students to the main construction techniques adopted in existing buildings, in relation to their technical, structural and energy performance, and to identify the main pathologies and degradation phenomena to which they may be subject. The two modules of the course refer to the most common types of constructive in the European territory: the load masonry structures and those in reinforced concrete.		
	97198 - REINFORCED CONCRETE BUILDINGS	ICAR/10	5	CORE LEARNING ACTIVITY Architecture and urbanism	Basic knowledge in technological characteristics of reinforced concrete buildings. Analysis of the pathologies and degradation of constructive elements.	50	75
	98107 - TRADITIONAL MASONRY BUILDINGS	ICAR/12	5	CORE LEARNING ACTIVITY Architecture and urbanism	Within the general objectives of the course, the module deepens the knowledge of: constructive principles and technical rules, pathologies, decay phenomena and deficits of traditional load-bearing masonry buildings, as well as their energy behavior.	50	75
98109	BASICS OF BUILDING PHYSICS	ING-IND/10	11				

	97199 - APPLIED ACOUSTICS AND LIGHTING	ING-IND/10	6	CORE LEARNING ACTIVITY Building industry and enviroment	The main aim of the module is to give the basic knowledge of building acoustics and lighting. The achieved competence will be a good knowledge of the basic physics needed to design end retrofit effectively acoustic and lighting layouts of existing buildings. Attention will be given also to current law and technical regulations, toghether with measurement and software design tools.	60	90
	98110 - HEAT AND MASS TRANSFER IN BUILDINGS	ING-IND/10	5	CORE LEARNING ACTIVITY Building industry and enviroment	Heat and Mass Transfer gives the engineer a firm grounding in the fundamental processes of conduction, convection and radiation heat transfer in buildings. Topics covered include transient conduction, forced convection in internal and external flow, free convection, lumped heat capacity analysis, two and three-dimensional heat transfer, radiation exchange between surfaces. Extensive applications in the field of buildings and civil engineering will be developed.	50	75
98106	STRUCTURAL MODELLING AND ANALYSIS OF EXISTING BUILDINGS	ICAR/08	10				
	98148 - STRUCTURAL MECHANICS	ICAR/08	5	CORE LEARNING ACTIVITY Building industry and enviroment	Basic knowledge in structural mechanics modeling for buildings: frames, plates and shells. Fundamentals in structural dynamics: linear, elasto-plastic, isolated oscillators. Simple design criteria of passive control systems for building retrofitting. Experimental modal analysis through reduced scale-modeling in the laboratory.	50	75
	98149 - STRUCTURAL MODELLING OF EXISTING BUILDINGS	ICAR/08	5	CORE LEARNING ACTIVITY Building industry and enviroment	Mechanical modeling of materials and structures for the assessment of existing buildings. Fundamentals in structural modeling and analysis of masonry and reinforced concrete buildings. Basics of computational modeling of existing buildings with computational laboratory activities	50	75

5 ECTS to be acquired from the 1st to the 2nd year:

97218	ACOUSTIC DESIGN FOR BUILDINGS	ING-IND/11	5	STUDENT'S ELECTIVE LEARNING ACTIVITY Student's elective learning activity	The course will deliver competence in building acoustics for design of buildings and rooms in buildings so that the acoustic environment fulfills the requirements from community and users. Competence should include understanding the effect of noise loads from internal and external sources and the use of theoretical and empirical methods to design buildings with satisfying sound insulation against noise. The student will also develop skills on room acoustics, i.e. develop understanding of how sound spreads in volumes and what it takes to achieve desired sound quality in rooms by using modeling and analysis. Finally, the course will give knowledge of measuring technique for room acoustics and sound insulation.	50	75

98122	FORENSIC ENGINEERING	ICAR/09	5	STUDENT'S ELECTIVE LEARNING ACTIVITY Student's elective learning activity	The course aims to provide students with operational notions related to the forensic expert activity, the role of the engineer in civil conflicts (CTU, CTP), the forensic expert activity as a support to the issues addressed by the TAR, the insurance appraisals, the new alternative dispute resolution system.	50	75

Second year (2022/2023)

Code	Teaching unit EN	SSD	ECTS	Type	Training objectives	Hours for assisted teaching activities	Hours for personal study
98121	TECHNIQUES FOR BUILDING REHABILITATION AND RESTORATION		10				
	98119 - TECHNIQUES FOR BUILDING REHABILITATION	ICAR/10	5	CORE LEARNING ACTIVITY Architecture and urbanism	The course will illustrate the methodological and technical problems present in a refurbishment project concerning the building envelope, with particular attention to materials and construction techniques.	50	75
	98120 - CONSERVATION AND RESTORATION OF EXISTING BUILDINGS	ICAR/19	5	CORE LEARNING ACTIVITY Architecture and urbanism	The course aims to make students aware on issues related to the preservation, maintenance, restoration and enhancement of architectural heritage, which is a testimony of our past, providing the historical-theoretical cornerstones and basic knowledge of the discipline, as well as basic technical skills for the design of the interventions.	50	75
97215	STRUCTURAL RETROFITTING AND STRENGTHENING TECHNIQUES	ICAR/09	5	CORE LEARNING ACTIVITY Building industry and enviroment	Classification of structural retrofitting interventions on existing buildings: maintenance, damage repair, local interventions, overall strengthening. Strategies for the choice of interventions: force versus deformation capacity, reversibility, durability, cost-benefit analysis. From the diagnosis to the design of interventions (monitoring, provisional works). Conceptual classification of strengthening techniques: traditional solutions versus use of innovative materials. Masonry buildings: foundations; masonry walls (cracks repair, widespread strengthening, improvement of connections); arches and vaults; floors and roof (bending strengthening, diaphragm effect); local interventions (creation of new openings or framing of existing ones); seismic improvement. Reinforced concrete structures: restoration of concrete; reinforcement of elements and nodes with composite materials; dissipative bracings; selective weakening and use fuse (elements of sacrifice).	50	75

97216	STRUCTURAL REHABILITATION WORKSHOP	ICAR/09	9	CORE LEARNING ACTIVITY Building industry and enviroment	The workshop aims to integrate the knowledge acquired in the structural area into an application path that, starting from the knowledge of the existing building, through the assessment of its safety and structural diagnosis, leads to the design of structural strengthening (where needed), taking into account all the technical, functional, economic and conservation issues that always characterise actual retrofitting problems.	90	135
98151	THESIS WORKSHOP		12	FINAL EXAMINATION For the final examination	The final thesis consists in the development of a specific project that asses the scientific, technical and professional skills gained by the student at the end of his studies.	0	300
98150	TRAINEESHIP		6	OTHER ACTIVITY Training and orientation traineeships	To develop a self-employment work to deepen theoretical or applicative problems or project development in the framework of a company/institution internship.	0	150
98182	PLANT DESIGN FOR BUILDINGS AND ENERGY REHABILITATION WORKSHOP	ING-IND/11	8	CORE LEARNING ACTIVITY Building industry and enviroment	The aim of the course is to provide knowledge on the most important renewable energy sources and the retrofitting of existing plants in buildings for their exploitation. Renewable enrgy, random energy resources sources and theri use. Tools for the analysis of technical and economic feasibility of plants for heating, cooling and ari conditioning of buildings. Fundamentals of electrical plants in buildings. References to current legisltive and technichal regulations on the subject. Use of the most tools for measurement, diagnostics and maintenance of buildings.	80	120

5 ECTS among the following courses:

98115	DESIGN AND CONSTRUCTION SITE MANAGEMENT	ICAR/11	5	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	The course gives an overview of the project in real estate (the role of project managers, stakeholders, the organizational arrangements and relationships with the company as a whole) and supplies chain design (customer relations, contractor and sub-contractor, contract types). Basics of BIM, as a tool for information management inside real estate services. Functional and technical characteristics of integrated information systems, impacts on building management organizations, and criteria for collection and treatment of data regarding buildings characteristics and maintenance activities. Construction site management.	50	75
98116	FIRE SAFETY DESIGN	ING-IND/10	5	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	The aim of the course is to provide the basis for fire-fighting design criteria in harmony with the criteria of the performance design - Fire Safety Engineering. Particular attention will be devoted to the definition and analysis of the development of fire scenarios. These topics are the prerequisites to the final study of the protection of occupants from the effects of the propagation of harmful effluents (Smoke), with specific software.	50	75

98117	RESILIENCE OF THE BUILT ENVIRONMENT	ICAR/09	5	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	Seismic risk analysis of the built environment in relation to natural events: hazard, exposure and vulnerability. Probabilistic seismic hazard assessment: occurrence of earthquakes, mitigation laws. Taxonomy and classification of the exposed assets. Vulnerability models: observational (macroseismic method), mechanical based (analytical or numerical) and hybrid methods. Evaluation of fragility curves from nonlinear dynamic analyzes (IDA, MSA and cloud method). Probabilistic framework for the calculation of risk. Analysis of economic consequences and losses (direct and indirect damage). The resilience of the built environment and the society: robustness and recovery time. Risk assessment, prevention and management of the seismic emergency in the case of monumental building: LV1 models, vulnerability and damage survey forms.	50	75

5 ECTS to be acquired from the 1st to the 2nd year:

97218	ACOUSTIC DESIGN FOR BUILDINGS	ING-IND/11	5	STUDENT'S ELECTIVE LEARNING ACTIVITY Student's elective learning activity	The course will deliver competence in building acoustics for design of buildings and rooms in buildings so that the acoustic environment fulfills the requirements from community and users. Competence should include understanding the effect of noise loads from internal and external sources and the use of theoretical and empirical methods to design buildings with satisfying sound insulation against noise. The student will also develop skills on room acoustics, i.e. develop understanding of how sound spreads in volumes and what it takes to achieve desired sound quality in rooms by using modeling and analysis. Finally, the course will give knowledge of measuring technique for room acoustics and sound insulation.	50	75
98122	FORENSIC ENGINEERING	ICAR/09	5	STUDENT'S ELECTIVE LEARNING ACTIVITY Student's elective learning activity	The course aims to provide students with operational notions related to the forensic expert activity, the role of the engineer in civil conflicts (CTU, CTP), the forensic expert activity as a support to the issues addressed by the TAR, the insurance appraisals, the new alternative dispute resolution system.	50	75

SCUOLA POLITECNICA – Dipartimento di Ingegneria Civile, Chimica e Ambientale (DICCA)
Corso di laurea magistrale in Engineering for Building Retrofitting
Classe LM-24 Ingegneria dei Sistemi Edilizi
REGOLAMENTO DIDATTICO
Parte generale
INDICE

Art. 1. Premessa e ambito di competenza

Il presente Regolamento, in conformità allo Statuto ed al Regolamento Didattico di Ateneo (parte generale e parte speciale), disciplina gli aspetti organizzativi dell'attività didattica del Corso di Laurea Magistrale in Engineering for Building Retrofitting nonché ogni diversa materia ad esso devoluta da altre fonti legislative e regolamentari.

Il Regolamento didattico del Corso di Laurea Magistrale in Engineering for Building Retrofitting è deliberato, ai sensi dell'articolo 25, commi 1 e 4 del Regolamento Didattico di Ateneo, parte generale, dal Consiglio di Corso di Studio (CCS) di Engineering for Building Retrofitting e sottoposto all'approvazione del Consiglio di Dipartimento DICCA, sentita la Scuola Politecnica, previo parere favorevole della Commissione Paritetica di Scuola.

Le delibere del CCS possono essere assunte anche in modalità telematica ai sensi dei sovraordinati regolamenti e, in particolare, dell'articolo 14 "Riunioni con modalità telematiche" del vigente Regolamento Generale di Ateneo (in vigore dal 19/12/2018).

Art. 2. Requisiti di ammissione. Modalità di verifica

L'ammissione al Corso di Laurea Magistrale in Engineering for Building Retrofitting (classe LM-24) è subordinata al possesso di specifici requisiti curricolari e di adeguatezza della preparazione personale.

Sono richiesti, senza esclusione, tutti i seguenti requisiti curricolari:

- possesso di Laurea triennale, conseguita in Italia, in una delle seguenti Classi: Ingegneria Civile e Ambientale (L-7 DM 270/2004, 08 DM 509/1999), Scienze e tecniche dell'edilizia (L-23 DM

270/2004), Scienze dell'architettura (L-17 DM 270/2004), Scienze dell'architettura e dell'ingegneria edile (04 DM 509/1999), Ingegneria Industriale (L-9 DM 270/2004, 10 DM 509/1999); in alternativa, possesso di Laurea Specialistica o Magistrale nelle seguenti Classi: Ingegneria Civile (LM-23 DM 270/2004, 28/S DM 509/1999), Ingegneria della sicurezza (LM-26 DM 270/2004), Architettura e Ingegneria Edile-Architettura (LM-4 DM 270/2004, 4/S DM 509/1999), Ingegneria Meccanica (LM-33 DM 270/2004, 36/S DM 509/1999), Ingegneria per l'Ambiente e il Territorio (LM-35 DM 270/2004, 38/S DM 509/1999); in alternativa, possesso di un altro titolo acquisito all'estero e riconosciuto idoneo;

- possesso di specifici numeri di CFU conseguiti in insiemi di Settori Scientifico-Disciplinari (SSD), caratterizzanti due delle aree di apprendimento fondamentali:
  - Area strutturale (ICAR07, ICAR08, ICAR09): minimo 15 CFU, di cui almeno 4 CFU nel SSD ICAR07 e 6 CFU nel SSD ICAR09;
  - Area impiantistica (INGIND10, INGIND11): minimo 8 CFU.
- capacità di utilizzare fluentemente, in forma scritta e orale, la lingua inglese, con riferimento anche ai lessici disciplinari (livello B2).

L'idoneità di titoli conseguiti all'estero viene riconosciuta dal competente consiglio di corso di studi sulla base di una valutazione del titolo accademico, delle attività formative (esami) svolte, e del cv.
L'ammissione al Corso di Laurea è automatica per coloro che hanno conseguito la laurea triennale italiana con una votazione finale di almeno 92/110.
Per coloro che hanno conseguito la laurea triennale italiana con una votazione finale inferiore a 92/110 e per coloro che abbiano conseguito un titolo all'estero, l'ammissione è condizionata alla valutazione del percorso accademico, delle attività formative svolte, del CV e, eventualmente, di un colloquio orale.
Per gli studenti extra-europei, la conoscenza della lingua inglese viene verificata attraverso la presentazione di una certificazione di livello non inferiore ad un B2 o scala equivalente. Sono ammessi i seguenti certificati:

- Cambridge;
- Trinity;
- IELTS;
- TOEFL iBT;
- IGCSE;
- The PeopleCert Group
- Oxford Test of English;
- Linguaskill.

Sia per gli studenti europei che per quelli extra UE che non abbiano una certificazione o attestazione di livello B2 o superiore, la conoscenza della lingua inglese può essere anche verificata tramite test on-line erogati dal settore di competenze linguistiche d'ateneo.

Art. 3. Attività formative

L'elenco degli insegnamenti e delle altre attività formative attivabili nella coorte 2022-23, è riportato nell'apposito allegato (ALL.1) che costituisce parte integrante del presente regolamento.
Per ogni insegnamento è individuato un docente responsabile. È docente responsabile di un insegnamento chi ne sia titolare a norma di legge, ovvero colui al quale il Consiglio di Dipartimento di afferenza abbia attribuito la responsabilità stessa in sede di affidamento dei compiti didattici ai docenti.

La lingua usata per erogare le attività formative (lezioni, esercitazioni, laboratori) è l'inglese, come indicato nell'allegato (ALL.1) al presente regolamento.

Art. 4. Iscrizione a singole attività formative

In conformità con l'articolo 5 del Regolamento di Ateneo per gli studenti, per iscriversi a singole attività formative occorre possedere un titolo di studio che permetta l'accesso all'Università

Art. 5. Curricula

Il corso di laurea magistrale in Engineering for Building Retrofitting non è articolato in curricula.

Art. 6. Impegno orario complessivo

La definizione della frazione oraria dedicata a lezioni o attività didattiche equivalenti è stabilita, per ogni insegnamento, dal CCS contestualmente alla definizione del Manifesto degli studi. In ogni caso si assume il seguente intervallo di variabilità della corrispondenza ore aula/ CFU: 8 ÷ 10 ore di lezione o di attività didattica assistita.

La definizione dell'impegno orario complessivo presunto, riservato allo studio personale o ad altre attività formative di tipo individuale, è stabilito, per ogni insegnamento, nell'allegato (ALL.1) del presente regolamento.

Il Direttore del dipartimento DICCA e il Coordinatore del CCS sono incaricati di verificare il rispetto delle predette prescrizioni.

Art. 7. Piani di studio e propedeuticità

Gli studenti possono iscriversi a tempo pieno o a tempo parziale; per le due tipologie di studente sono previsti differenti diritti e doveri.
Lo studente sceglie la tipologia di iscrizione contestualmente alla presentazione del piano di studio.
Lo studente a tempo pieno svolge la propria attività formativa tenendo conto del piano di studio predisposto dal corso di laurea magistrale, distinto per anni di corso e pubblicato nel Manifesto degli studi. Il piano di studio formulato dallo studente deve contenere l'indicazione delle attività formative, con i relativi crediti che intende conseguire, previsti dal piano di studio ufficiale per tale periodo didattico, fino ad un massimo di 65 dei crediti previsti in ogni anno.

Lo studente a tempo parziale è tenuto a presentare un piano di studio individuale specificando il numero di crediti che intende inserire secondo quanto disposto dal regolamento per la contribuzione studentesca di Ateneo.
L'iscrizione degli studenti a tempo pieno e a tempo parziale è disciplinata dal regolamento di Ateneo per gli studenti tenuto conto delle disposizioni operative deliberate dagli Organi centrali di Governo ed indicate nella Guida dello studente (pubblicata annualmente sul sito web dell'Università).
Il percorso formativo dello studente è stato organizzato secondo criteri di propedeuticità. Pertanto il piano di studio è fortemente consigliato in coerenza con il percorso formativo.
Il CCS, con esplicita e motivata deliberazione, può autorizzare gli studenti che nell'anno accademico precedente abbiano dimostrato un rendimento negli studi particolarmente elevato ad inserire nel proprio piano di studio un numero di crediti superiore a 65, ma in ogni caso non superiore a 75.
Per "rendimento particolarmente elevato" si intende che lo studente abbia superato tutti gli esami del proprio piano di studio entro il mese di settembre.
Il piano di studio articolato su una durata più breve rispetto a quella normale, è approvato sia dal Consiglio dei Corsi di Studio.
La modalità e il termine per la presentazione del piano di studio sono stabiliti annualmente dalla Scuola

Politecnica e riportate sul sito web del corso di studio alla pagina "Studenti".
Lo studente può aggiungere nel proprio percorso formativo insegnamenti "fuori piano" fino ad un massimo di 12 cfu senza versare ulteriori contributi.

Art. 8. Frequenza e modalità di svolgimento delle attività didattiche

Gli insegnamenti possono assumere la forma di: (a) lezioni, anche a distanza mediante mezzi telematici; (b) esercitazioni pratiche; (c) esercitazioni in laboratorio; (d) seminari tematici.
Il profilo articolato e la natura impegnativa delle lezioni tenute nell'ambito del corso di studio rendono la frequenza alle attività formative fortemente consigliata per una adeguata comprensione degli argomenti e quindi per una buona riuscita negli esami. Il calendario delle lezioni è articolato in semestri. Di norma, il semestre è suddiviso in almeno 12 settimane di lezione più almeno 4 settimane complessive per prove di verifica ed esami di profitto. Il periodo destinato agli esami di profitto termina con l'inizio delle lezioni del semestre successivo. L'orario delle lezioni per l'intero anno accademico è pubblicato sul sito web del CdS prima dell'inizio delle lezioni dell'anno accademico. L'orario delle lezioni garantisce la possibilità di frequenza per anni di corso previsti dal vigente Manifesto degli studi. Per ragioni pratiche non è garantita la compatibilità dell'orario per tutte le scelte formalmente possibili degli insegnamenti opzionali. Gli studenti devono quindi formulare il proprio piano di studio tenendo conto dell'orario delle lezioni.
l tirocinio previsto nel percorso formativo può essere svolto, a partire dal secondo anno, nei laboratori del DICCA, in altre Università, Centri di Ricerca, Aziende, Enti Pubblici, etc. Nel caso di programmi di mobilità per esami o tesi all'estero il tirocinio può essere proposto anche nella sede estera in cui viene svolto il programma.

Art. 9. Esami e altre verifiche del profitto

Gli esami di profitto possono essere svolti in forma scritta, orale, o scritta e orale, secondo le modalità indicate nelle schede di ciascun insegnamento pubblicato sul sito web di Ateneo e accessibili anche da quello del Corso di Laurea Magistrale.

A richiesta, possono essere previste specifiche modalità di verifica dell'apprendimento che tengano conto delle esigenze di studenti disabili e di studenti con disturbi specifici dell'apprendimento (D.S.A.), in conformità all'art. 20 comma 4 del Regolamento Didattico di Ateneo.
La lingua usata per lo svolgimento degli esami di profitto è l'inglese.
Nel caso di insegnamenti strutturati in moduli con più docenti, questi partecipano collegialmente alla valutazione complessiva del profitto dello studente che non può, comunque, essere frazionata in valutazioni separate sui singoli moduli.
Il calendario degli esami di profitto è stabilito secondo le scadenze ministeriali e viene pubblicato sul sito web di Ateneo e accessibile da quello del corso di laurea magistrale. Il calendario delle eventuali prove di verifica in itinere è stabilito dal CCS e comunicato agli studenti all'inizio di ogni ciclo didattico.
Gli esami si svolgono nei periodi di interruzione delle lezioni. Possono essere previsti appelli durante il periodo delle lezioni soltanto per gli studenti che, nell'anno accademico in corso, non abbiano inserito attività formative nel proprio piano di studio.
Tutte le verifiche del profitto relative alle attività formative debbono essere superate entro la scadenza prevista dalla segreteria studenti della Scuola Politecnica in vista della prova finale, come indicato nel "promemoria" pubblicato sul sito web di Ateneo e accessibile anche da quello del CdS.
L'esito dell'esame, con la votazione conseguita, è verbalizzato secondo quanto previsto all'art. 29 del regolamento didattico di Ateneo.
Le commissioni di esame di profitto sono nominate dal coordinatore del corso di studio e sono composte da almeno 3 componenti, di cui due membri effettivi dei quali uno è il docente responsabile dell'insegnamento. Nel caso in cui la percentuale di superamento per l'insegnamento sia inferiore al 30% consecutivamente per due anni accademici la commissione sarà composta da almeno 5 docenti e la verbalizzazione dovrà

certificare la presenza effettiva di almeno 3 componenti. Possono essere componenti della commissione cultori della materia individuati dal consiglio del corso di studio sulla base di criteri che assicurino il possesso di requisiti scientifici, didattici o professionali; tali requisiti si possono presumere posseduti da parte di docenti universitari a riposo. Le commissioni sono presiedute dal docente responsabile dell'insegnamento e per ognuna va individuato un presidente supplente.

Art.10. Riconoscimento di crediti

Il CCS delibera sull'approvazione delle domande di passaggio o trasferimento da un altro corso di studi dell'Ateneo o di altre Università secondo le norme previste dal Regolamento didattico di Ateneo, art. 18. Delibera altresì l'eventuale riconoscimento, quale credito formativo, per un numero massimo di 12 CFU, di conoscenze e abilità professionali certificate ai sensi della normativa vigente.

Nella valutazione delle domande di passaggio si terrà conto delle specificità didattiche e dell'attualità dei contenuti formativi dei singoli esami sostenuti, riservandosi di stabilire di volta in volta eventuali forme di verifica ed esami integrativi.

Art. 11. Mobilità, studi compiuti all'estero, scambi internazionali

Il CCS incoraggia fortemente le attività di internazionalizzazione, in particolare la partecipazione degli studenti ai programmi di mobilità e di scambi internazionali. A tal fine garantisce, secondo le modalità previste dalle norme vigenti, il riconoscimento dei crediti formativi conseguiti all'interno di tali programmi, e organizza le attività didattiche opportunamente in modo da rendere agevoli ed efficaci tali attività.

Il CCS riconosce agli studenti iscritti, che abbiano regolarmente svolto e completato un periodo di studi all'estero, gli esami sostenuti fuori sede e il conseguimento dei relativi crediti che lo studente intenda sostituire ad esami del proprio piano di studi.
Ai fini dei riconoscimenti, lo studente all'atto della compilazione del piano delle attività formative che intende seguire nell'ateneo estero, dovrà produrre idonea documentazione comprovante l'equivalenza dei contenuti tra l'insegnamento impartito all'estero e l'insegnamento che intende sostituire, impartito nel corso di laurea magistrale in Engineering for Building Retrofitting. L'equivalenza è valutata dal CCS.
La conversione dei voti avverrà secondo criteri approvati dal CCS, congruenti con il sistema europeo ECTS.

Per periodi di studio dedicati alla preparazione della prova finale, il numero di crediti riconosciuto, relativi a tale fattispecie, è messo in relazione alla durata del periodo svolto all'estero.

Art. 12. Modalità della prova finale

La prova finale consiste nella discussione di un elaborato scritto, tendente ad accertare la preparazione tecnico-scientifica e professionale del candidato.
Ai fini del conseguimento della laurea magistrale, l'elaborato finale consiste nella redazione di una tesi (di carattere teorico, sperimentale o applicativo) elaborata dallo studente in modo originale sotto la guida di uno o più relatori, su argomenti definiti attinenti ad una disciplina di cui il candidato abbia superato l'esame; la tesi deve essere comunque coerente con gli argomenti sviluppati nel corso della laurea magistrale.
Tra i relatori deve essere presente almeno un docente del corso di studio.
La tesi è redatta in lingua Inglese; al candidato potrà essere richiesta, dal CCS per tramite del relatore, la redazione di un sommario in lingua italiana.
In caso di utilizzo di altra lingua rispetto all'inglese è necessaria l'autorizzazione del CCS, la traduzione del titolo e la stesura di un ampio sommario in inglese.
La tesi dovrà rivelare le capacità dello studente nell'affrontare tematiche di tipo applicativo e/o di ricerca.
La tesi dovrà essere costituita da un progetto e/o dallo sviluppo di un'applicazione che proponga soluzioni

innovative rispetto allo stato dell'arte.
La tesi dovrà altresì rivelare:

- ✓ adeguata preparazione nelle discipline caratterizzanti la laurea magistrale;
- ✓ corretto uso delle fonti e della bibliografia;
- ✓ capacità sistematiche e argomentative;
- ✓ chiarezza nell'esposizione;
- ✓ capacità progettuale e sperimentale;
- ✓ capacità critica.

L'impegno richiesto allo studente per la preparazione della prova finale è commisurato al numero di crediti assegnati alla prova stessa.
La Commissione per la prova finale è composta da almeno cinque componenti, professori e ricercatori di ruolo, compreso il Presidente ed è nominata dal Direttore del Dipartimento DICCA.

Le modalità di svolgimento della prova finale consistono nella presentazione orale della tesi di laurea da parte dello studente alla commissione per la prova finale, seguita da una discussione sulle questioni eventualmente poste dai componenti la commissione.
La valutazione della prova finale da parte della commissione avviene, in caso di superamento della stessa, attribuendo un incremento, variabile da 0 a 6 (massimo stabilito dalla Scuola di concerto con i Dipartimenti e riportato nel Manifesto degli Studi), alla media ponderata dei voti riportati nelle prove di verifica relative ad attività formative che prevedono una votazione finale, assumendo come peso il numero di crediti associati alla singola attività formativa.
Tra gli aspetti che concorrono alla definizione del punteggio attribuito alla prova finale, la Commissione dovrà particolarmente tenere in conto:

- qualità, completezza e originalità dell'elaborato (fino ad un massimo di 3 punti);

- esposizione dell'elaborato (fino ad un massimo di 1 punto);

- valutazione della carriera dello studente (durata degli studi del candidato, votazioni con lode, eventuale periodo svolto all'estero per la redazione dell'elaborato o di una sua consistente parte) fino ad un massimo di 2 punti.

La lode viene conferita, in presenza dell'approvazione unanime della Commissione, a studenti che abbiano conseguito una valutazione finale di almeno 110 punti. La dignità di stampa per il lavoro di tesi magistrale può essere richiesta dal relatore ai membri della Commissione di Laurea almeno 15 giorni prima della seduta di laurea, illustrandone le motivazioni. La dignità di stampa viene attribuita con voto unanime della Commissione della seduta di Laurea.

Art. 13. Orientamento e tutorato

La Scuola Politecnica, di concerto con il Dipartimento DICCA, organizza e gestisce un servizio di tutorato per l'accoglienza e il sostegno degli studenti al fine di promuovere i diversi percorsi formativi di secondo livello. Il Corso di Studio individua al suo interno due docenti tutor al fine di supportare gli studenti iscritti al corso.

Art. 14. Verifica dell'obsolescenza dei crediti

I crediti formativi universitari acquisiti nell'ambito del corso di laurea possono essere sottoposti a verifica di obsolescenza dopo 6 anni. Qualora il CCS riconosca l'obsolescenza anche di una sola parte dei relativi contenuti formativi, lo stesso CCS stabilisce le prove integrative che dovranno essere sostenute dallo

studente, definendo gli argomenti delle stesse, le modalità di verifica, la composizione della commissione di esame.
Una volta superate le verifiche previste, il CCS convalida i crediti acquisiti con apposita delibera. Qualora la relativa attività formativa preveda una votazione, la stessa potrà essere variata rispetto a quella precedentemente ottenuta, su proposta della Commissione d'esame che ha proceduto alla verifica.

Art. 15. Manifesto degli Studi

Il Dipartimento DICCA, sentita la Scuola Politecnica, approva e pubblica annualmente il Manifesto degli studi del Corso di Laurea Magistrale. Nel Manifesto sono indicate le principali disposizioni dell'ordinamento didattico e del regolamento didattico del corso di laurea magistrale, a cui eventualmente si aggiungono indicazioni integrative.

Il Manifesto degli studi del Corso di Laurea Magistrale contiene l'elenco degli insegnamenti attivati per l'anno accademico in questione. Le schede dei singoli insegnamenti sono pubblicati sul sito web di Ateneo e accessibili da quello del Corso di Laurea Magistrale.

Allegato 1 Parte speciale del Regolamento didattico del Corso di Laurea Magistrale in Engineering for Building Retrofitting della Scuola Politecnica

Elenco delle attività formative attivabili e relativi obiettivi formativi

Primo anno -coorte 2022- 2023

Codice	Nome insegnamento	SSD	CFU	Tipologia/Ambito	Obiettivi formativi	Ore riservate attività didattica assisitta	Ore riservate allo studio personale
97209	DIGITAL SURVEY OF BUILDINGS	ICAR/17	5	AFFINI o INTEGRATIVI Attività formative affini o integrative	The course aims to teach the most recent technologies in the field of architectural survey today, both as regards the primary moment of the survey that is the phase of acquisition of the metric data, both as regards the representation and the study of objects of architectural, artistic and archaeological interest.	50	75
98114	BUILDING ECONOMICS AND EVALUATION OF PROJECTS		8				
	109204 - BUILDING ECONOMICS	ICAR/22	4	AFFINI o INTEGRATIVI Attività formative affini o integrative	The course on Buildings Economics provides the basics elements on cost-benefit analysis and knowledge on methodologies for the valuation of investment projects. Attention is dedicated to net present value, internal rate of return, payback period and profitability index so to take into account cash flows (costs and revenues) over time as well as techniques for the management of risk and uncertainty with applications to case studies for the valuation of real-estate construction, renovation, investment and management.	40	60
	98113 - ECONOMIC EVALUATION OF PROJECTS	ICAR/22	4	AFFINI o INTEGRATIVI Attività formative affini o integrative	The course deals with the theoretical and operational tools related to the economic and financial sustainability assessment of interventions on built heritage at the construction and urban scale.	40	60

98111	STRUCTURAL AND GEOTECHNICAL ASSESSMENT OF EXISTING BUILDINGS		11				
	97204 - STRUCTURAL ASSESSMENT AND SAFETY OF EXISTING BUILDINGS	ICAR/09	6	CARATTERIZZANTE Edilizia e ambiente	The course deals with the safety assessment of existing buildings. Differently from the perspective of design of new constructions, the behavior of the structure is unknown at the beginning of the analysis requiring effective procedures to face the problem of such incomplete knowledge that involves both aleatory and epistemic (e.g. related to the effectiveness of structural details) uncertainties. The course faces both issues related, on the one hand, to the diagnosis to ordinary actions and, on the other, to the prevention against rare events. The wide variety of behaviors that characterize no standardized existing buildings makes more conventional the use of methods of analysis quite common in the design of new structures, such as the linear ones. For this reason, the course devotes large attention to the nonlinear static procedures. Finally, among rare actions, since existing buildings have been often conceived without specific rules for the seismic action, such vulnerability constitutes one of most relevant which the course focuses to, with particular attention to both masonry and reinforced concrete structures.	60	90
	97205 - GEOTECHNICAL PROBLEMS IN BUILT ENVIRONMENT	ICAR/07	5	CARATTERIZZANTE Edilizia e ambiente	The aim of the course is to analyze some of the main aspects related to soil-structure interaction phenomena that occur in the built environment. Since the focus is on existing buildings, after a first part that deals with the types of foundation and the basic methods used in practice for settlement assessment and bearing capacity calculation, the issues of greatest interest, due to external and natural causes (e.g. slope movements, soil liquefaction, groundwater oscillations, subsidence, etc.) and anthropogenic (e .g. deep excavations, shallow tunnels, etc.), are detailed and studied in depth. The course also provides the knowledge and skills to students on design and intervention guidelines relating to the foundation-soil system, such as the strengthening of foundations, underpinnig and soil improvement.	50	75
98108	CONSTRUCTION TECHNIQUES, DAMAGE AND DETERIORATION OF BUILDINGS		10		The course aims to introduce the students to the main construction techniques adopted in existing buildings, in relation to their technical, structural and energy performance, and to identify the main pathologies and degradation phenomena to which they may be subject. The two modules of the course refer to the most common types of constructive in the European territory: the load masonry structures and those in reinforced concrete.		

	97198 - REINFORCED CONCRETE BUILDINGS	ICAR/10	5	CARATTERIZZANTE Architettura e urbanistica	Basic knowledge in technological characteristics of reinforced concrete buildings. Analysis of the pathologies and degradation of constructive elements.	50	75
	98107 - TRADITIONAL MASONRY BUILDINGS	ICAR/12	5	CARATTERIZZANTE Architettura e urbanistica	Within the general objectives of the course, the module deepens the knowledge of: constructive principles and technical rules, pathologies, decay phenomena and deficits of traditional load-bearing masonry buildings, as well as their energy behavior.	50	75
98109	BASICS OF BUILDING PHYSICS	ING-IND/10	11				
	97199 - APPLIED ACOUSTICS AND LIGHTING	ING-IND/10	6	CARATTERIZZANTE Edilizia e ambiente	The main aim of the module is to give the basic knowledge of building acoustics and lighting. The achieved competence will be a good knowledge of the basic physics needed to design end retrofit effectively acoustic and lighting layouts of existing buildings. Attention will be given also to current law and technical regulations, toghether with measurement and software design tools.	60	90
	98110 - HEAT AND MASS TRANSFER IN BUILDINGS	ING-IND/10	5	CARATTERIZZANTE Edilizia e ambiente	Heat and Mass Transfer gives the engineer a firm grounding in the fundamental processes of conduction, convection and radiation heat transfer in buildings. Topics covered include transient conduction, forced convection in internal and external flow, free convection, lumped heat capacity analysis, two and three-dimensional heat transfer, radiation exchange between surfaces. Extensive applications in the field of buildings and civil engineering will be developed.	50	75
98106	STRUCTURAL MODELLING AND ANALYSIS OF EXISTING BUILDINGS	ICAR/08	10				
	98148 - STRUCTURAL MECHANICS	ICAR/08	5	CARATTERIZZANTE Edilizia e ambiente	Basic knowledge in structural mechanics modeling for buildings: frames, plates and shells. Fundamentals in structural dynamics: linear, elasto-plastic, isolated oscillators. Simple design criteria of passive control systems for building retrofitting. Experimental modal analysis through reduced scale-modeling in the laboratory.	50	75
	98149 - STRUCTURAL MODELLING OF EXISTING BUILDINGS	ICAR/08	5	CARATTERIZZANTE Edilizia e ambiente	Mechanical modeling of materials and structures for the assessment of existing buildings. Fundamentals in structural modeling and analysis of masonry and reinforced concrete buildings. Basics of computational modeling of existing buildings with computational laboratory activities	50	75

5 CFU a scelta tra:

97218	ACOUSTIC DESIGN FOR BUILDINGS	ING-IND/11	5	A SCELTA A scelta dello studente	The course will deliver competence in building acoustics for design of buildings and rooms in buildings so that the acoustic environment fulfills the requirements from community and users. Competence should include understanding the effect of noise loads from internal and external sources and the use of theoretical and empirical methods to design buildings with satisfying sound insulation against noise. The student will also develop skills on room acoustics, i.e. develop understanding of how sound spreads in volumes and what it takes to achieve desired sound quality in rooms by using modeling and analysis. Finally, the course will give knowledge of measuring technique for room acoustics and sound insulation.	50	75
98122	FORENSIC ENGINEERING	ICAR/09	5	A SCELTA A scelta dello studente	The course aims to provide students with operational notions related to the forensic expert activity, the role of the engineer in civil conflicts (CTU, CTP), the forensic expert activity as a support to the issues addressed by the TAR, the insurance appraisals, the new alternative dispute resolution system.	50	75

Secondo anno-coorte 2022-23

Codice	Nome insegnamento	SSD	CFU	Tipologia/Ambito	Obiettivi formativi	Ore riservate attività didattica assisitta	Ore riservate allo studio personale
98121	TECHNIQUES FOR BUILDING REHABILITATION AND RESTORATION		10				
	98119 - TECHNIQUES FOR BUILDING REHABILITATION	ICAR/10	5	CARATTERIZZANTE Architettura e urbanistica	The course will illustrate the methodological and technical problems present in a refurbishment project concerning the building envelope, with particular attention to materials and construction techniques.	50	75

	98120 - CONSERVATION AND RESTORATION OF EXISTING BUILDINGS	ICAR/19	5	CARATTERIZZANTE Architettura e urbanistica	The course aims to make students aware on issues related to the preservation, maintenance, restoration and enhancement of architectural heritage, which is a testimony of our past, providing the historical-theoretical cornerstones and basic knowledge of the discipline, as well as basic technical skills for the design of the interventions.	50	75
97215	STRUCTURAL RETROFITTING AND STRENGTHENING TECHNIQUES	ICAR/09	5	CARATTERIZZANTE Architettura e urbanistica	Classification of structural retrofitting interventions on existing buildings: maintenance, damage repair, local interventions, overall strengthening. Strategies for the choice of interventions: force versus deformation capacity, reversibility, durability, cost-benefit analysis. From the diagnosis to the design of interventions (monitoring, provisional works). Conceptual classification of strengthening techniques: traditional solutions versus use of innovative materials. Masonry buildings: foundations; masonry walls (cracks repair, widespread strengthening, improvement of connections); arches and vaults; floors and roof (bending strengthening, diaphragm effect); local interventions (creation of new openings or framing of existing ones); seismic improvement. Reinforced concrete structures: restoration of concrete; reinforcement of elements and nodes with composite materials; dissipative bracings; selective weakening and use fuse (elements of sacrifice).	50	75
97216	STRUCTURAL REHABILITATION WORKSHOP	ICAR/09	9	CARATTERIZZANTE Architettura e urbanistica	The workshop aims to integrate the knowledge acquired in the structural area into an application path that, starting from the knowledge of the existing building, through the assessment of its safety and structural diagnosis, leads to the design of structural strengthening (where needed), taking into account all the technical, functional, economic and conservation issues that always characterise actual retrofitting problems.	90	135
98182	PLANT DESIGN FOR BUILDINGS AND ENERGY REHABILITATION WORKSHOP	ING-IND/11	8	CARATTERIZZANTE Architettura e urbanistica	The aim of the course is to provide knowledge on the most important renewable energy sources and the retrofitting of existing plants in buildings for their exploitation. Renewable enrgy, random energy resources sources and theri use. Tools for the analysis of technical and economic feasibility of plants for heating, cooling and ari conditioning of buildings. Fundamentals of electrical plants in buildings. References to current legisltive and technichal regulations on the subject. Use of the most tools for measurement, diagnostics and maintenance of buildings.	80	120
98151	THESIS WORKSHOP		12	PROVA FINALE Per la prova finale	The final thesis consists in the development of a specific project that asses the scientific, technical and professional skills gained by the student at the end of his studies.	0	300

98150	TRAINEESHIP		6	ALTRE ATTIVITA' Tirocini formativi e di orientamento	To develop a self-employment work to deepen theoretical or applicative problems or project development in the framework of a company/institution internship.	0	150

5 CFU tra questi:

98115	DESIGN AND CONSTRUCTION SITE MANAGEMENT	ICAR/11	5		The course gives an overview of the project in real estate (the role of project managers, stakeholders, the organizational arrangements and relationships with the company as a whole) and supplies chain design (customer relations, contractor and sub-contractor, contract types). Basics of BIM, as a tool for information management inside real estate services. Functional and technical characteristics of integrated information systems, impacts on building management organizations, and criteria for collection and treatment of data regarding buildings characteristics and maintenance activities. Construction site management.	50	75
98116	FIRE SAFETY DESIGN	ING-IND/10	5	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	The aim of the course is to provide the basis for fire-fighting design criteria in harmony with the criteria of the performance design - Fire Safety Engineering. Particular attention will be devoted to the definition and analysis of the development of fire scenarios. These topics are the prerequisites to the final study of the protection of occupants from the effects of the propagation of harmful effluents (Smoke), with specific software.	50	75
98117	RESILIENCE OF THE BUILT ENVIRONMENT	ICAR/09	5	RELATED OR SUPPLEMENTARY LEARNING ACTIVITY Related or Supplementary learning activity	Seismic risk analysis of the built environment in relation to natural events: hazard, exposure and vulnerability. Probabilistic seismic hazard assessment: occurrence of earthquakes, mitigation laws. Taxonomy and classification of the exposed assets. Vulnerability models: observational (macroseismic method), mechanical based (analytical or numerical) and hybrid methods. Evaluation of fragility curves from nonlinear dynamic analyzes (IDA, MSA and cloud method). Probabilistic framework for the calculation of risk. Analysis of economic consequences and losses (direct and indirect damage). The resilience of the built environment and the society: robustness and recovery time. Risk assessment, prevention and management of the seismic emergency in the case of monumental building: LV1 models, vulnerability and damage survey forms.	50	75

5 CFU a scelta tra:

97218	ACOUSTIC DESIGN FOR BUILDINGS	ING-IND/11	5	STUDENT'S ELECTIVE LEARNING ACTIVITY Student's elective learning activity	The course will deliver competence in building acoustics for design of buildings and rooms in buildings so that the acoustic environment fulfills the requirements from community and users. Competence should include understanding the effect of noise loads from internal and external sources and the use of theoretical and empirical methods to design buildings with satisfying sound insulation against noise. The student will also develop skills on room acoustics, i.e. develop understanding of how sound spreads in volumes and what it takes to achieve desired sound quality in rooms by using modeling and analysis. Finally, the course will give knowledge of measuring technique for room acoustics and sound insulation.	50	75
98122	FORENSIC ENGINEERING	ICAR/09	5	STUDENT'S ELECTIVE LEARNING ACTIVITY Student's elective learning activity	The course aims to provide students with operational notions related to the forensic expert activity, the role of the engineer in civil conflicts (CTU, CTP), the forensic expert activity as a support to the issues addressed by the TAR, the insurance appraisals, the new alternative dispute resolution system.	50	75