

Transilvania University of Braşov, Romania

Study program: Energy modernization in the built environment

Faculty: Civil Engineering

Study period: 2 years (master)

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Advanced numerical analysis	ANA	5	2	-	2	-

Course description (Syllabus): The aim of the course consists in the methods of numerical calculus presentation and there uses for the advanced numerical analyse most used in civil engineering area. The linear and nonlinear system of equations covers, the root of transcendental equations, the finite different approximations, functional interpolation and extrapolation, the integrals approximations by numerical methods, the matrix numerical operations, finite elements and volume method are presented with relevant engineering examples. The solvers are based on Matlab interpreter and C/C++ compilers with relevant observations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Systems and measuring equipment and specific data acquisition and facilities construction	SEMADSCI	6	2	-	2	-

Course description (Syllabus): Mainly the course consists in the experimental methods of the solid bodies, offer the minimal information concerning on stress-, is placements-, and strain-evaluations. In this sense, there are described the most significant experimental methods (Electrical Strain Gauge Method, Moire Fringe, Photo-elasticity, Holographic Interferometry, Electronic Speckle Pattern Interferometry and Video Image Correlation). By means of them, the students will be able selecting the most proper and efficient experimental approach in validation and monitoring of different engineering structures' stress-strain states. There are illustrated by several laboratory works the main advantages and limits of these methods.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Heuristic design in architecture and structural engineering	EPAIS	6	2			2

Course description (Syllabus): Analysis, interpretation and understanding of the complex processes that lead to the realization of architectural objects during the percourse theme - conditioning - concepts - solutions - project – built reality, and the exploration of structural engineering requirements in relation to the characteristics and features that give to the architecture potential from the primary, functional and cultural-symbolic meanings point of view, for the creation of the premises of the sustainable dialogue in practice between the specialists in the field of structural engineering and architects.

Main issues: 1. Introduction to design heuristics in architecture and structural engineering (reality, image, imaginary, typologies, process, phenomenon). 2. Foray into the history, theory and critique of the relationship between architecture and structural engineering to explore the development of architectural styles, emblematic currents, specific influences and how they relate to the conditionings of structural engineering. 3. The concept in architectural design and structural engineering: how to think of an architectural object, the relationship of construction materials/structural systems - destination/function - form/expression in contemporary design. 4. Design with added value for energy modernization in the built universe: exploring the concepts and theories of solar, bioclimatic, passive architecture and the extent and limits of their integration in contemporary design in architecture and structural

engineering. 5. High-tech versus low-tech dichotomy in architecture and structural engineering: a synthesis between the requirements of structural engineering, the requirements of functional-aesthetic architectural design and the requirements of energy efficiency in the context of sustainable principles in relation to changes in the philosophy of contemporary architecture. 6. Architecture and structural engineering in the virtual ideal dichotomy and/versus constructed reality. 7. Exploring the architectural process: the concept and elaboration phases of the solution, expectations, challenges, conditionings that appear in the work from the theme to the architectural object materialized by the project and understanding the challenges involved in carrying out a specific architectural project, its modernization and the challenges of energy modernization of buildings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Integrated renewable energy systems in the built environment	SERMC	6	2	-	-	2

Course description (Syllabus): The courses present measurement at the temperature, pressure and flow. Temperature measurement, also known as thermometry, describes the process of measuring a current local temperature for immediate or later evaluation. Pressure measurement is the analysis of an applied force by a fluid on a surface. We'll present many techniques have been developed for the measurement of pressure. Flow measurement is the quantification of bulk fluid movement. Flow can be measured in a variety of ways. Positive-displacement flow meters accumulate a fixed volume of fluid and then count the number of times the volume is filled to measure flow. Other flow measurement methods rely on forces produced by the flowing stream as it overcomes a known constriction, to indirectly calculate flow. Flow may be measured by measuring the velocity of fluid over a known area.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Ethics and academic integrity	EIA	2	1	-	-	-

Course description (Syllabus): The main objective of the course Ethics and academic Integrity is to know and acquire, from the master's students, the concepts of ethics and integrity - specific to the academic deontology, in order to be applied in the present didactic work, as well as in the development of a future responsible professional career.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity I (11 hours / week)	SP01	6	-	-	-	-

Course description (Syllabus): The main objective of Practical activity I (Internship I) is to identify and know the structural elements and building services related to constructions in general and understand the mechanisms of degradations of their technical condition. The Practical activity I (Internship I) is carried out in units with concerns in the field of constructions and building services, under the guidance of a mentor responsible for this activity.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rehabilitation of infrastructure and the foundation soil	RICTF	6	2	-	-	2

Course description (Syllabus): The course is structured in two parts: rehabilitation of the foundation soil and rehabilitation of constructions infrastructure. In the first part are describe the methods for consolidated of soil foundation, by means shallow processes and deep processes. In the second part are describe the main causes of degradation foundations, the forms of manifestation, the methods of investigation and rehabilitation of foundations. So, are describe the classical methods of consolidation, by coating, by addition of new element, by concrete pouring under foot foundation, and the deep methods of consolidation by means micro piles, introduced in soil by drilling and by hitting. The theoretical aspects are materialized in a practical application concerning the consolidation of foundation soil.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Waterproofing of buildings	HICO	6	2	2		

Course description (Syllabus): The main objective of this course is to acquire and develop the knowledge and basic notions regarding the design, execution and time tracking of waterproofing works, both for the superstructure and infrastructure levels of a building; technical expertise of the degradation state and identification of the optimal solution / solutions for the rehabilitation of the existing waterproofing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity II (12 hours / week)	SP02	7	-	-	-	-

Course description (Syllabus). The main objective of the course is to identify and know the causes of degradation and the forms of manifestation of the degradations specific to the constructions and the afferent installations, in order to design the technical solutions of structural and functional rehabilitation. The Practical activity II (Internship II) is carried out in units with concerns in the field of constructions and installations, under the guidance of a mentor responsible for this activity and is an opportunity for the preparation of the dissertation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modern structures made of prestressed concrete	SMBP	6	2	-	-	2

Course description (Syllabus): The course is structured in two parts: fundamental elements concerning the prestressing of concrete (historic short, tension, comparative elements between reinforced and prestressed concrete, methods of prestressing, areas of application, etc.) and basic elements regarding conception, designing and composition of modern structures of prestressed concrete. Are presented in this sense, theoretical and practical aspects concerning composition concept of each structural components and of structure in general, with exemplification on existing constructions. The applicative part represents an exemplification on a construction for which are known initial dates and encompass two part: the written part (the theme, planning statement, task book, notes of calculation and the drawn part (formwork plan, reinforced plan, section, details, etc.)

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Design of structures to earthquakes	CSAS	6	2	-	-	2

Course description (Syllabus): Design of structures to earthquakes is a basic core course at the Master's level in Structural Engineering. The present Design of structures to earthquakes course introduces the basic concepts of numerical methods in dynamics of structure. In the first part of the course uses response spectra method which is based on the numerical solution of Duhamel's integral. The second part deals with the numerical integration methods (time history methods) for systems with n degrees of dynamic freedom. In the third part of the course, we analyse general aspects regarding the isolation of the base and vibration absorbers.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rheology of construction materials	RMC	5	2	2	-	-

Course description (Syllabus): The aim of the course is to identify the strains and stresses states that change over time as a result of the constant loading or the simultaneous action of the aggressive environmental factors on the building materials both in the stage of their preparation and after their implementation. The rheological models that govern the strains of the rheological systems in correlation with the stresses, the equations regarding the strains rate of the building materials, the modification of their specific properties in relation to the environmental factors are issues addressed during the course. The expected results aim at perform a project in which the rheological models of the used systems and their rheological properties are developed.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fracture mechanics and fatigue design of steel structures	MR	5	2	2		

Course description (Syllabus): General objectives of the course: knowledge of the use and implementation of fatigue design of steel structures; assessment of the failure risk and identification of methods for applying the mechanical principles of fracture of the steel elements and structures; establishing solutions to reduce the risk of failure.

Specific objectives of the course: development of the capacity to use and apply the mechanical principles of fracture for steel structure; development of the ability to identify appropriate algorithms for calculating the structural integrity for steel structures, taken into account the initial and critical defect.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modern systems of heating and district hot water for buildings	SMIPAAC	6	2	-	-	2

Course description (Syllabus): The discipline ensures in preparing students to: methods of calculus of heat load for heat in buildings, methods of heat regulation in buildings, calculus of hydraulic networks, thermal calculus of heat networks, calculus of heat consumption of buildings using Mc001, cogeneration of heat for buildings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Efficient ventilation and air conditioning systems	SEVCA	5	2	2	-	-

Course description (Syllabus): "Air only" air conditioning systems; "air-water" air conditioning systems; "air-refrigerant" air conditioning systems; energy consumption for air conditioning systems; natural ventilation single side, cross, stack effect and night cooling; sun protection; air tightness of buildings; double skin façade; the passive house; Simulation of natural ventilation systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Equipment in buildings using solar energy	IUCBES	6	2	-	2	-

Course description (Syllabus): Solar energy-based equipment represents a useful issue to reduce CO₂ emissions in the built environment and a presentation of the advantages together with their limits is a necessary information for students preparing a master degree in the field of energetic modernization of buildings. Examples of different types of renewable energy technologies followed by solar-thermal applications in the building sector has as scope to open the interest of students for a field largely developed in the last years. How to calculate the necessary surface of a solar-panel system to cover the domestic hot water (DHW) consumption is described and a numerical example is treated. Concepts like on *site/nearby renewable sources* are introduced to explain the *Renewable Energy Ratio* as the key factor to reduce the primary energy use.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity II (12 hours / week)	SP02	7	-	-	-	-

Course description (Syllabus). The main objective of the course is to identify and know the causes of degradation and the forms of manifestation of the degradations specific to the constructions and the afferent installations, in order to design the technical solutions of structural and functional rehabilitation. The Practical activity II (Internship II) is carried out in units with concerns in the field of constructions and installations, under the guidance of a mentor responsible for this activity and is an opportunity for the preparation of the dissertation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy simulation in buildings	SEC	6	2	-	2	-

Course description (Syllabus): Integrative modelling methods – response function methods, frequency domain response functions, numerical methods; Building simulation – system discretisation, finite volume energy equation formulation; Processing the building energy equations – establishing the energy matrix equation, matrix partitioning for fast simultaneous solution; Fluid flow – the nodal network method; Computational fluid dynamics – domain discretisation, conserving energy, mass, momentum and species concentration.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Comfort in buildings	CAC	6	2	-	2	-

Course description (Syllabus): Main objectives are knowing the notion of environmental comfort in buildings, ways of realization, designing and the operation of the building installation to obtain the ambient comfort. Also, the acquisition of data, analytical skills and assessment of thermal comfort and microclimate in buildings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rehabilitation of infrastructure for construction engineering systems	RITCI	6	2	-	-	2

Course description (Syllabus): The course is structured in two parts: rehabilitation of the foundation soil and rehabilitation of constructions infrastructure. In the first part are describe the methods for consolidated of soil foundation, by means shallow processes and deep processes. In the second part are describe the main causes of degradation foundations, the forms of manifestation, the methods of investigation and rehabilitation of foundations. So, are describe the classical methods of consolidation, by coating, by addition of new element, by concrete pouring under foot foundation, and the deep methods of consolidation by means micro piles, introduced in soil by drilling and by hitting. The theoretical aspects are materialized in two practical applications concerning the consolidation of a building foundations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Materials for constructions engineering systems	MCI	6	2	2	-	-

Course description (Syllabus): This course is related to "Railways, roads and bridges" study program. It aims to treats, deeply, issues concerning materials used in this field on interest, such as mineral binders, bitumen, concrete admixtures and composites, as well as durability aspects according to national and European regulations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computational methods for modernization and rehabilitation of construction engineering systems	MCRMCI	6	2	-	2	-

Course description (Syllabus): This course deals with the use of computational methods for the modernization and rehabilitation of construction engineering systems. There are presented matrix methods for the advanced study of nonlinear behaviour of truss and tensegrity structures, nonlinear finite element methods for the study of stability of railways subjected to vehicle loads and temperature variations and advanced finite element computations for the study of the behaviour of flexible and rigid road structures subjected to traffic loads.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity II (12 hours / week)	SP02	7	-	-	-	-

Course description (Syllabus): The main objective of the course is to identify and know the causes of degradation and the forms of manifestation of the degradations specific to the constructions and the afferent installations, in order to design the technical solutions of structural and functional rehabilitation. The Practical activity II (Internship II) is carried out in units with concerns in the field of constructions and installations, under the guidance of a mentor responsible for this activity and is an opportunity for the preparation of the dissertation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rheology of construction materials	RMC	5	2	2	-	-

Course description (Syllabus): The aim of the course is to identify the strains and stresses states that change over time as a result of the constant loading or the simultaneous action of the aggressive environmental factors on the building materials both in the stage of their preparation and after their implementation. The rheological models that govern the strains of the rheological systems in correlation with the stresses, the equations regarding the strains rate of the building materials, the modification of their specific properties in relation to the environmental factors are issues addressed during the course. The expected results aim at perform a project in which the rheological models of the used systems and their rheological properties are developed.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fracture mechanics and fatigue design of steel structures	MR	5	2	2		

Course description (Syllabus): General objectives of the course: knowledge of the use and implementation of fatigue design of steel structures; assessment of the failure risk and identification of methods for applying the mechanical principles of fracture of the steel elements and structures; establishing solutions to reduce the risk of failure.

Specific objectives of the course: development of the capacity to use and apply the mechanical principles of fracture for steel structure; development of the ability to identify appropriate algorithms for calculating the structural integrity for steel structures, taken into account the initial and critical defect.

2nd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rehabilitation and strengthening of wood and masonry structures	RCSLZ	7	2	2	-	-

Course description (Syllabus): The course presents the theoretical knowledge regarding the diagnosis of degradations in the masonry structures, the design, execution and exploitation of the masonry works to which rehabilitation solutions have been applied. There will be issues regarding: degradation causes of masonry buildings; degradation quantitative and qualitative assessment; basic principles for building consolidation; alternatives for strengthening brick masonry structures.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rehabilitation of reinforced and prestressed concrete structures	RSBAP	7	2	-	-	2

Course description (Syllabus): The course presents the theoretical knowledge regarding the diagnosis of degradations in the concrete structures, the design, execution and exploitation of the concrete, reinforced concrete

and prestressed concrete works to which rehabilitation solutions have been applied. There will be issues regarding: degradation causes of concrete structures; degradation quantitative and qualitative assessment; basic principles for building consolidation; alternatives for strengthening concrete structures.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rehabilitation and strengthening of steel structures	RCSM	8	2	-	-	2

Course description (Syllabus): Evaluation of metallic structures; rehabilitation and retrofit of existing steel structures, seismic design of steel structures; methodologies for assessing metal structures; local interventions for structural improvement; global interventions for structural improvement.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Nonlinear computing elements of structures	ECNS	8	2	-	2	-

Course description (Syllabus): The aim of the course consists in the methods of nonlinear calculus presentation and there uses for the advanced analyse of structures. The simultaneous aspects of buckling and strength of structures subjected to extremely loads cases is wanted to determines. The elasto-plastic behaviour of materials on all the loading steps are in progress until the collapse of the structure. The imperfections of stresses distributions, the geometrical locales and global imperfections effects on nonlinear behaviour, the mechanical imperfections of the structural elements of the buildings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity and/or scientific research	AP/CS	30	-	-	-	-

Course description (Syllabus): This activity is deployed in construction specialized units, for students which follow a specialization route (1,2,3), when they follow the stages of achievement of construction/installation works, in general and the achievement of construction/installation rehabilitation works, in special or in constructions units/ research units / research laboratories / design units/services , all with concerns and realizations regarding energetic performances of buildings, for students which follow the research route (4). So, each student, no matter of followed route, are in directly contact with specific works of themes for dissertation work.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Development of dissertation work	PLD	10	-	-	-	-

Course description (Syllabus): The activity of development of dissertation work is deployed under guidance of professor coordinator, chosen by each student, function of work them. The theme of dissertation work is established by graduate student and coordinator professor, based on general thematic announced to the beginning of current university year and frame content of work. The preparation of dissertation them is coordinated by professor through regular meetings with students, after an established program and whenever is necessary. The coordinator professor participates to the support of dissertation work ahead of examine committee.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modern systems for electric lighting and natural light in buildings	SMINEC	8	2	-	-	2

Course description (Syllabus): Electrical lighting is the branch of applied science that has as object of study, the production of light and its use, so that the surrounding objects can be observed and in the absence of natural light. The

notion of electric lighting can be found in literature under other names, such as lighting, lighting technology or lighting engineering. Light is the form of existence of the electromagnetic field, capable of producing visual sensations on the eye. The electromagnetic field is in the form of an electromagnetic wave outside the bodies charged with electric charge. The course presents the theoretical and practical aspects of natural and artificial lighting in a building.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Water management in buildings and installations	MACIO3	8	2	2	-	-

Course description (Syllabus): The purpose of the course is to know and understand short- and long-term water policies at local, national and international level, and to select water supply and sewerage systems for buildings, building assemblies and localities. Identifying means and solutions to reduce water consumption, optimize water distribution systems and collect and store and use rainwater to reduce drinking water consumption is another purpose of the course.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy management in buildings	MECIA	7	2	2	-	-

Course description (Syllabus): The aim of the course consists in: facility and operations management; financial management —budget planning; human resources — staffing, training, and performance standards; maintenance; supply management — procurement procedures, energy purchasing and equipment and materials; building and plant design; new product/process development teams; communications marketing; environmental and Safety.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modern materials and technologies for building services	MTMRIC	7	2	-	2	-

Course description (Syllabus): Building materials play major role in achieving energy efficiency within the built environment. At this course the students learn what are the most common and actual materials and technologies used in building services domain. The course cover plumbing, sewage, firefighting, heating, ventilation and air conditioning, electrical, natural gas, refrigeration and cryogenic systems. The topics are focused on efficient use of natural, new, recyclable, modern technologies, new methods for building services.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity and/or scientific research	AP/CS	30	-	-	-	-

Course description (Syllabus): This activity is deployed in construction specialized units, for students which follow a specialization route (1,2,3), when they follow the stages of achievement of construction/installation works, in general and the achievement of construction/installation rehabilitation works, in special or in constructions units/ research units / research laboratories / design units/services , all with concerns and realizations regarding energetic performances of buildings, for students which follow the research route (4). So, each student, no matter of followed route, are in directly contact with specific works of themes for dissertation work.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Development of dissertation work	PLD	10	-	-	-	-

Course description (Syllabus): The activity of development of dissertation work is deployed under guidance of professor coordinator, chosen by each student, function of work them. The theme of dissertation work is established by graduate student and coordinator professor, based on general thematic announced to the beginning of current

university year and frame content of work. The preparation of dissertation them is coordinated by professor through regular meetings with students, after an established program and whenever is necessary. The coordinator professor participates to the support of dissertation work ahead of examine committee.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modernization and rehabilitation of roads	MRCCR	8	2	-	-	2

Course description (Syllabus): The learning of the theoretical aspects related to investigating, recognizing and applying remedies to resolve the degradations appeared the use of roads, gaining knowledge of new technologies and equipment's related to modernization and rehabilitation of roads, environmental problems and general contract conditions specific to road construction. The student is able to carry out calculations to measure the reinforcement needed to rehabilitate the roads. The course ensures advanced knowledge in using some materials in the rehabilitation of roads, knowledge of aspects of road maintenance and rehabilitation and presenting some computer programs specific to various domains and types of infrastructures.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Rehabilitation of bridges	RPRF	7	2	-	-	2

Course description (Syllabus): This course studies the methodology of investigation and verification of the bridge structures according to the type of the structure. Based on the identification of the state of degradation and the technical condition, the necessary technical solutions for the rehabilitation of the bridges will be established. Also there are addressed issues to receive and check the quality of the works, the necessary conditions both in the design and the execution of the bridges.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modernization and rehabilitation of railways	MRCCF	7	2	-	-	2

Course description (Syllabus): The aim of this course is to: Deepen the theoretical and practical aspects of the railway field; Extend the knowledge to specific elements regarding the design and execution of the modernization and rehabilitation works of the railway communication paths; Knowledge transfer for the identification of embankment and path defects and principles for the construction, maintenance and consolidation of embankments and track elements.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Special works for the modernization and rehabilitation of roads and railways	LSMRCCRF	8	2	-	-	2

Course description (Syllabus): The main objective of this course is to present the newest technologies for modernization and rehabilitation of roads and railways. The problems in this domain are very complex and need knowledges from different other courses like Geotechnical Engineering, Foundation, Roads, Railways etc. After completing the course and project the students will know to make connections, to evaluate correctly the solution that need to be taken in different situation and where to search the information they need to design or put in practice a project for this type of works.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity and/or scientific research	AP/CS	30	-	-	-	-

Course description (Syllabus): This activity is deployed in construction specialized units, for students which follow a specialization route (1,2,3), when they follow the stages of achievement of construction/installation works, in general and the achievement of construction/installation rehabilitation works, in special or in constructions units/ research units / research laboratories / design units/services , all with concerns and realizations regarding energetic

performances of buildings, for students which follow the research route (4). So, each student, no matter of followed route, are in directly contact with specific works of themes for dissertation work.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Development of dissertation work	PLD	10	-	-	-	-

Course description (Syllabus): The activity of development of dissertation work is deployed under guidance of professor coordinator, chosen by each student, function of work them. The theme of dissertation work is established by graduate student and coordinator professor, based on general thematic announced to the beginning of current university year and frame content of work. The preparation of dissertation them is coordinated by professor through regular meetings with students, after an established program and whenever is necessary. The coordinator professor participates to the support of dissertation work ahead of examine committee.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energetical performance optimization of buildings envelope	OPEAC	8	2	-	2	-

Course description (Syllabus): The course is aimed to follow the recast *Energy Performance of Building Directive* (EPBD) issued by REHVA in Brussels in order to familiarize master students with the requirements concerning the Greenhouse Gases reduction as a necessary mean to mitigate the Climate Change. Structured for High and Low Rise Buildings respectively, the content take into account the existing and the new build environment. Insulation characteristic of materials, thermal bridges, optimal cost of the rehabilitation process ea. are analysed in order to develop an understanding of the level of importance of different issues that can be used in the process of optimization of building envelope performance. *Nearly Zero Energy Building* (NZEB) concept is presented together with examples realized in different EU countries. The exchange of best practices among Member States (MSs) to a more effective implementation of the EPBD in our country is presented.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Constructions bases modeling systems	BMSSC	8	2	-	2	-

Course description (Syllabus): Modelling and simulation is all about using digital models as a real time object to research and study the emphasis and consequences of an action. Although the tools used here are digital, they are far more advanced and give a better perspective to the researchers. The digital environment helps the researchers and scientists to control and manipulate the factors that might affect the functioning of a machine or system and derive conclusions regarding the ideal conditions that will provide the best utility of a system.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Building's services bases modeling systems	BMSSI	8	2	-	2	-

Course description (Syllabus): Modelling and simulation is all about using digital models as a real time object to research consequences of an action. Although the tools used here are digital, they are far more advanced and give a better perspective to the researchers. The digital environment helps the researchers and scientists to control and manipulate the factors that might affect the functioning of a machine or system and derive conclusions regarding the ideal conditions that will provide the best utility of a system.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Optimizing the energy performance of integrated building systems	OPESIIC	7	2	-	2	-

Course description (Syllabus): The discipline ensures in preparing students the field of energy efficiency of facilities, the main problems: methods for calculation of the design heat load: SR EN 1907/2014, SR EN 12831, SR EN 4839/2014; methods of optimizing the thermal protection of buildings; calculation of energy consumption and energy efficiency of heating systems in buildings; efficient equipment for heating and domestic hot water in buildings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Performance optimization of hygrothermal and acoustic solutions in buildings	OSPHAC	7	2	-	2	-

Course description (Syllabus): The overall objective of this course is to acquire knowledge of performance in the hygrothermal and acoustic design of buildings by adopting the most optimal solutions for constructing building envelope elements.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Performance optimization of natural lighting and ventilation systems in buildings	OESIVNIC	7	2	-	2	-

Course description (Syllabus): The course presents the theoretical and practical aspects of natural and artificial lighting in a building. The notion of natural lighting can be found in literature under other names, such as lighting, lighting technology or lighting engineering. Light is the form of existence of the electromagnetic field, capable of producing visual sensations on the eye. Ventilation includes both outdoor air exchange and air circulation inside the building. It is one of the most important factors for maintaining air quality in an acceptable interior in buildings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Evaluation and certification of buildings energy performance.	ECPEC	7	2	-	2	-

Course description (Syllabus): By content the course follows to cover all stages for determination of buildings energetic characteristics and afferent installations, to certify the energetic performance. For this, are presented the base aspects regarding the concept of performance in general, the concept of energetic performance in special, historic short concerning evolution of the energetic performance concept in Romania and in world. The energetic characteristics of building envelope elements, the energetic consumptions for heating and utilities conduct to evaluation and certification of energetic performance for new buildings or existing building after thermal rehabilitation. Evaluation and certification of energetic performances for an existing building is solved by practical application developed in parallel during semester.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity and/or scientific research	AP/CS	30	-	-	-	-

Course description (Syllabus): This activity is deployed in construction specialized units, for students which follow a specialization route (1,2,3), when they follow the stages of achievement of construction/installation works, in general and the achievement of construction/installation rehabilitation works, in special or in constructions units/ research units / research laboratories / design units/services , all with concerns and realizations regarding energetic performances of buildings, for students which follow the research route (4). So, each student, no matter of followed route, are in directly contact with specific works of themes for dissertation work.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Development of dissertation work	PLD	10	-	-	-	-

Course description (Syllabus): The activity of development of dissertation work is deployed under guidance of professor coordinator, chosen by each student, function of work them. The theme of dissertation work is established by graduate student and coordinator professor, based on general thematic announced to the beginning of current university year and frame content of work. The preparation of dissertation them is coordinated by professor through regular meetings with students, after an established program and whenever is necessary. The coordinator professor participates to the support of dissertation work ahead of examine committee.