Promoting academia-industry alliances for R&D through collaborative and open innovation platform - All4R&D

LLL COURSES & INNOVATIVE PRACTICES

HANDBOOK

Co-funded by the Erasmus+ Programme of the European Union

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PROJECT DESCRIPTION

The aim of the project **"Promoting academia-industry alliances for R&D through collaborative and open innovation platform"** - All4R&D is to accelerate research, innovation, knowledge and technology transfer in Bosnia and Herzegovina and Armenia through enhancing strategic academia-industry alliances. The project is funded as part of the Erasmus+ Program "Capacity building in Higher Education" in the period 15.11.2018 – 14.11.2022. More information about the project can be found on https://all4rd.net/.

The **specific project objectives** are:

- To reinforce existing and to establish new university structures – Cooperative R&D Units together with industry; partners in the areas of knowledge creation and transfer, research and innovation, commercialisation of R&D results;
- To develop a methodology for collaboration and open innovation and establish web-based platform focusing on knowledge transfer, innovation and networking potential;
- To test and review the model of collaboration between universities and companies through pilot projects; and
- To enhance career development and employability of students and alumni by offering new and innovative opportunities in research and education.

The following stakeholders are **potential user**s of the project results:

- Academic and research institutions
- Industry partners (private companies, especially those who have strong research and innovation potential)
- Students and alumni
- Government agencies, ministries, public enterprises; business and professional associations
- Investing agencies and third-party funds.

RESULTS

The excellence of this project is provided by developing and application of a unique approach of establishing specific, wide-ranged, interactive, comprehensive connection between academia and industry, one being an inspiration and a confirmation to the other. Through synergetic partnership of 13 organisations the academia-industry alliances built in holistic approach which provides vital human capital, with skills and competences needed today. Our motivation was the understanding that when companies and universities work in tandem they can push the frontiers of knowledge, and become a powerful engine for innovation and economic growth. One of the key project results in the **Collaborative and Open Innovation All4R&D Platform** (http://platform.all4rd.net/), which to bridge universities and companies and overcoming the challenges in their collaboration.

INTRODUCTION

The project activities are aligned with the national priorities of Bosnia and Herzegovina and Armenia, as well as with the international priorities. In frame of the projects, **four Cooperative R&D Units** were established:

- R&D Unit University of Sarajevo & WP
- R&D Unit Dzemal Bijedic University of Mostar & HP
- R&D Unit National Polytechnic University of Armenia Foundation & Institute for Informatics and Automation Problems of the National Academy of Sciences of the Republic of Armenia
- R&D Unit National University Architecture and Construction of Armenia & Yerevan Telecommunication Research Institute, Armenia

The Cooperative R&D Units and Collaborative and Open Innovation All4R&D Platform makes knowledge triangle possible, and develops strategic and long-term collaboration between academia and industry.

With this accomplishing these objectives the project will strengthen the relations between HEIs and the wider economic and social environment in Bosnia and Herzegovina and Armenia. When university and industry collaborate in an innovation project, they create a collaborative unit that can be considered as one innovative enterprise with its own 'strategic control' and 'organizational integration' as some of the key social concepts.

In the scope of the All4R&D project 50 professional courses and 35 innovative practices have been developed. The courses were co-created and were offered in joint collaboration of academic and business organisations from 6 countries (Armenia, Bosnia and Herzegovina, North Macedonia, Germany, Finland and Austria). All courses were in English and employ innovative teaching methods. Enrolment in these courses was done via three open calls.

DEVELOPMENT

The offered courses were tailored-made, based on a Gap analysis for assessing the skills, capacities and training needs of alumni and professionals, and trends in industry.

The gap analysis provided significant insight in the competencies gap that students and alumni have. The purpose of the gap analysis was to identify the difference between the current performance and desired performance. The gap analysis also provided training needs assessment, focusing on students and professionals (alumni) and understanding their needs. With this assessment identification of the problems and needs regarding knowledge, skills and competencies was done.

Employers (managers) gave input to the performance analysis, provided insight on the importance of the skills students and professionals have, should have, as well as their satisfaction on the current situation. The performance analysis provided a list of knowledge and skills that are deficiency.

Additionally, as part of this analysis two round-tables were organized in Sarajevo and Yerevan by University of Sarajevo and National University Architecture and Construction of Armenia on "Closing the competencies' gap – offering new training courses and innovative services to students and alumni".

Having in mind the global economy and industry challenges and trends, such as development of IT, automation, globalization changes, workplace changes and increased expectations of employers, through literature review, we selected number of skills and competencies. They are all employability skills for the 21st century work place identified from extensive research and practice. These skills – hard and soft, are essential, needed for the job market. Students and professionals need to develop these skills, because they are transferable (especially the soft skills) across job types and employment levels, and are not job specific.

As a conclusion from the round-tables and the survey analysis the following topics for courses and innovative services and activities were recommended:

- Eurocodes
- BIM
- Earthquake engineering
- Wind engineering
- Digitalization
- Computer science
- Geo-informatics
- Geotechnics
- Materials
- Testing and Monitoring of Structures
- Computer tools in Engineering
- Computer tools in Business
- Engineering ethics
- Corporate Social Responsibility
- Risk management

The results of the survey were used to develop new training courses and innovative activities, in collaboration between Teachers from partners in the Consortium and the Cooperative R&D Units. 3 Workshops were organised, dedicated for presenting and developing the LLL courses and innovative practices:

- Online seminar "LLL Courses – proposals", held on 20.5.2020
- Online seminar "Thematic LLL Courses Online Workshop", held on 3.6.2020 and 4.6.2020
- Online seminar "Innovative teaching/training practices – proposal", held on 30.6.2020

After the courses were completed, all courses were peer-reviewed by Teachers in the Consortium.

The developed courses and innovative practices were offered on the online platform, where students, alumni and professionals from the industry have access to get more-in depth knowledge on the needed topics. All of the new developed training courses and innovative practices by the Teachers and professions were implemented using the web based platform. The working methods included digital

tools for online learning, innovative and interactive methods of learning live video sessions, consultation hours etc.

All participants who completed successfully the courses were awarded an international certificate for attendance/completion of the course for 60h (equivalent to 2 ECTs).

Criteria for participation in the courses were:

- English proficiency;
- Attend the full duration of the course;
- Complete the workload of 60 hours for each selected course (online classes and self-guided learning);
- Create a profile and take an active part in our collaborative-innovative platform;
- Desire to learn and exchange with peers in an international environment.

ALL4R&D COURSES

The 50 developed courses were co-created and offered in joint collaboration of academic and business organizations from 5 different countries. Moreover, the training courses were categorized in 6 different topics.

Infrastructure

Infrastructure refers to the basic facilities and systems that help society function, including buildings, roads, utilities and other systems. Civil infrastructure systems include the design, analysis, and management of infrastructures that support human activities, including electricity, oil and gas, water and wastewater, communication, transportation, and the collection of buildings that make up urban and rural communities. These courses include civil engineering topics such as structures, hydraulics, geotechnics and surveying. The trainees can also study the planning and construction of sustainable infrastructures with a focus on water technology, traffic, freeway and energy sector.

Earthquake engineering

Earthquake Engineering relies on the disciplines of structural engineering, structural dynamics, seismology, materials engineering, geotechnics, risk and decision analysis as well as probability and reliability theory in order to comprehensively record infrastructure performance in an uncertain seismic future. Earthquake engineers examine the reasons why infrastructure and buildings fail in the event of an earthquake, and then apply their knowledge to the planning, designing, construction, and management of earthquake-resistant structures and facilities. The trainees gain insight into the underlying principles of structural earthquake technology, including: analysis of seismic hazards, structural dynamics and inelastic behaviour.

Structural Materials and Engineering

Structural engineering is a branch of civil engineering, in which the laws of physics, mathematics and empirical knowledge are used to safely construct the supporting elements of structures. Contemporary structural engineering provides extensive and detailed knowledge that can be used to accurately predict the performance of various shapes and materials used in structures to withstand loads and stresses on structures. Structural engineering includes the analysis and design of structures such as buildings, bridges, towers, shipbuilding, dams, tunnels, retaining walls and other infrastructures. It supports and maintains the built environment in which buildings must be safe, maintainable, long-lasting and aesthetically pleasing and economical. Structural engineers apply mathematics and physics to traditional building materials such as concrete, stone, steel, wood and glass as well as to innovative technical materials such as aluminium, polymers and carbon fibres.

IT & Software

A variety of courses that cover wide range of exciting and contemporary IT topics such as innovation systems, embedded systems in the field of energy efficiency, use of cloud tools to ensure the quality of research and education, use big data analytics and visualization for better decision making, mobile programming for iOS and android devices, object-oriented and interactive programming in python, software design process, software technologies and design methodology, application of video content as a tool for blended learning, introduction to contemporary cyber-security threats, vulnerabilities attacks and security methods, and other similar topics.

Engineering Software Tools

Modern engineering requires use of various software tools for rapid and accurate analysis and prototyping which enables efficient and economical execution of engineering projects. This group of courses is geared towards covering various topics concerned with the use of state-of-the-art software tools in engineering practice and research, such as CAD oriented software, structural analysis software, Building Information Modelling (BIM) as well as use of virtual reality VR simulation and digital manufacturing.

Management

A group of courses encompassing specialized topics mostly addressing entrepreneurship and management. Trainees are able to acquire knowledge in risk management, marketing management or managing intellectual capital, or get familiar in areas such as engineering ethics or emotional intelligence at the workplace.

INFRASTRUCTURE

AIR QUALITY MODELLING

Course Description

The focus of this course is put on description and modelling of particle and gas dispersion in the built environment driven by atmospheric wind and includes also threat scenarios and threshold value considerations. Different numerical approaches are discussed and demonstrated by examples. This includes the different transport mechanisms, the understanding and description of the wind flow as well as different treatment / implementation in a simulation software.

The validation data for air pollution scenarios is generated through the adaption of a tracer gas technology using analysis instruments as well as an analog/digital test environment will be explained.

Course Content

- Introduction:-practical background and examples of use
- Air Pollutants: the transported medium
- Wind: the transport medium
- Transport processes: interaction of wind and pollutant
- Models: transport and dispersion models
- Validation: numerical and physical model

Pre-requisites

- none

Target group

- Students
- Professionals
- Managers

Learning objectives

- Explain practical current examples and applications on the topic of "dispersion in the near-ground atmosphere.
- Describe the relevance of the considered technical fields and the validation of the quality of engineering models using measurement data.

Teacher

Cornelia Kalender,
Ruhr University Bochum

WIND ENGINEERING

Course Description

Students will learn about the main wind energy structures that occur in practice and those that will be built in the future. Statistical descriptions for wind as a resource or as an influence for potentiality or for load estimation are used. In addition, relevant wind effects and their relevance in structural design and life cycle assessment are discussed in terms of structural safety and design. For this purpose, computational and some experimental methods for wind impact assessment are considered that can be applied to special questions.

The requirement of data-based validation is shown for each application. The validation data can be generated by scaled experiments, e.g. using boundary layer wind tunnels, or data from full scale experiments. At Ruhr University Bochum, a suitable type of wind tunnel is available, which is a boundary layer wind tunnel with the typical, anisotropic turbulence structure as in the atmosphere for near reality investigations of the complete built environment through scaled model experiments.

Course Content

- Explain practical current examples and applications on the topic of "dispersion in the near-ground atmosphere“ and to describe the basic mechanisms of the transport of substances by wind in a subject-specific manner.

Pre-requisites

- none

Target group

- Students
- Professionals
- Managers

Learning objectives

- Describe the relevance of the considered technical fields and the validation of the quality of engineering models using measurement data from model and real experiments.
- Properly assess engineering decisions in the treated technical field under consideration of the nature of the wind effects, of the quality of the engineering model and the suitability of the approach.

Teacher

Rüdiger Höffer
Ruhr University Bochum

RENEWABLE ENERGY SOURCES

Course Description

Within the available fund of hours, students will be introduced to the field of sustainable management of natural resources; basics of different forms of renewable energy sources. The course will provide the necessary background knowledge to continue studying various different forms of renewable energy sources.

Course Content

- Definition of Renewables
- Definition of Non - Renewables
- Overview of energy in the world
- Renewable energy sources
- Hydropower
- Biomass
- Wind energy
- Solar energy
- Geothermal energy
- Tidal energy
- Wave energy
- Ocean thermal energy conversion (OTEC)
- Hydrogen energy
- RES benefits
- Problems and limitations
- Current trends
- Potential and forecasts
- RES in Bosnia and Herzegovina

Pre-requisites

- Basic knowledge of renewable energy sources.

Target group

- Students
- Professionals
- Managers

Learning objectives

- Understanding of terms sustainability.
- Understanding of terms of RES and nonRES.
- Awareness of different forms of RES.
- Provide the basic knowledge to continue studying various different forms of renewable energy sources.

Teacher

Elvir Zlomušica
Dzemal Bijedic University of Mostar

WATER SUPPLY SYSTEM (RESOURCE, USAGE, RISK, RISK MANAGEMENT)

Course Description

Water resources management around the world has been based on improving the quality and quantity of water, while paying attention to maintaining healthy ecosystems, and securing water during drought. These challenges have been particularly intensified in urban areas due to rapid water resources deterioration around the world, caused by a combined effect of global warming, climate changes, population growth, and fast development. While these factors are becoming more and more obvious, new challenges emerge, prompted by studies that focus on the (improvement of) management of this endangered resource both in terms of quality and quantity. Therefore, the purpose of this course is to provide help to the water utilities sector, thereby leading to a better water management, and securing the long-term financial sustainability of this sector.

Course Content

- Managing the process of water pipeline network rehabilitation
- Elements of fuzzy set theory, fuzzy logic and the concept of fuzzy decision-making theory
- Application of fuzzy reasoning in assessing condition of water pipe network, cost efficiency measures and risk of pipe deterioration consequences
- Model of managing of a process of water supply network repairing by using fuzzy logic and fuzzy inference

Pre-requisites

- Knowledge of water supply system

Target group

- The management of water utility companies, as well as to planners for the water sector, or for any other sector related to water use, sustainable ecological management, or ecosystem and water preservation.

Learning objectives

- Understanding some of the advanced techniques aspects of management, which present the basis for economically sustainable and reliable functioning of the water supply system.
- Introducing the concept of water utility management is the way for future educated professionals, who can contribute to a sustainable and more successful water utility management, both in local water utilities, as well as water resources management at large.

Teacher

Suad Špago
Dzemal Bijedic University of Mostar

METHODS AND TOOLS FOR IMPROVEMENT OF URBAN PLANNING: ZONING AND GIS BASIC

Course Description

The course introduces learners to the concept of urban planning and zoning, presenting differences between possible and forced development, focusing importance of understanding spatial potentials, city growth, residence needs, and other factors that play crucial role in planning of the city. All this, of course in line with sustainability, nature friendly, heritage respectfully and human scale approaches. Course gives overview of planning on all scales, starting with city development plans, zoning of city areas, and so on till urban project for particular sites. This overview provides understanding of interconnectedness.

Along with approaches and processes of urban planning course gives basic introduction to one of the tools that is helpful in all these processes – GIS. Students will be introduced to its possibilities, use in planning and in monitoring spatial development as well as planning and monitoring of use of different infrastructure systems.

Course Content

- Concept of urban planning and zoning
- Overview of advantages of zoning approach compared to traditional ones
- Presentation of whole planning process
- GIS – possibility and uses.

Pre-requisites

- None

Target group

- Students
- Professionals
- Managers

Learning objectives

- Clear understanding of definition of urban planning and zoning methodology.
- Understanding importance of cities in the future (Agenda 2030).
- Knowledge of basic action in zoning and GIS.
- Understanding of basic concept of sustainable cities and importance of Zoning and GIS in that sense.

Teacher

Suad Špago
Senada Demirović Habibija
Dzemal Bijedic University of Mostar

HYDRAULIC MODELLING OF NATURAL FLOWS

Course Description

Hydraulic modelling, nowadays, is essential engineering tool which could be used for planning regulating of rivers to prevent flooding, planning artificial lakes, to model dam brake and wave it causing, to make risk maps, and to simulate river flow for many other objectives related to river caused problems. In this short course hydrology and hydraulic model coupled into one will be presented, and presented as example in case study of modelling river Lasva in Bosnia and Hercegovina. These models are the base for extended models of sediment or contamination transport, but it is not topic of this course.

Course Content

- Introduction to theoretical background of catchment and river flow.
- Hydrological catchment modelling using MIKE11 Rainfall/runoff models: necessary input data, model calibration and validation.
- Analysis of steady state and transient hydraulic models using MIKE11: for natural flow, for different structural types (bridges, culverts, weirs,…) located in the river bed. Work in case of lack of data.
- Exporting flooding maps with characteristics of flood (depth, duration of flood).

Pre-requisites

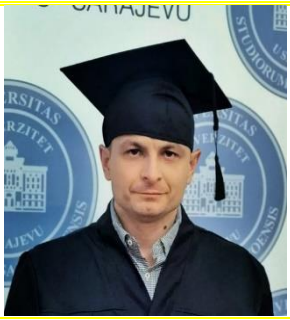
- None

Target group

- Students
- Professionals
- Managers

Learning objectives

- Mastering of theoretical basics and modelling of natural watercourses using commercial solvers.
- Strong relation to practical use.



Teacher

Haris Kalajdzisalihovic
University of Sarajevo

GEOTECHNICAL ENGINEERING IN URBAN ENVIRONMENT

Course Description

According to UN, 68% of the world population projected to live in urban areas by 2050. This trend leads to many new development and infrastructure projects in large cities and requires complex geotechnical works in close proximity of sensitive buildings. A proper engineering knowledge is necessary to deal with these problems and the course "Geotechnical engineering in urban environment" gives introduction to this topic.

Course Content

- Introduction to geotechnical engineering in urban environment with real-life examples.
- Design of standard pile wall supporting systems and innovations in implementation of jet grouting solutions.
- Standard calculation methods and numerical modelling utilizing Plaxis.
- Calculation of wall horizontal deflections, vertical settlements and overall system stability.
- Design of various anchoring systems, technical aspects of groundwater management.

Pre-requisites

- Basic knowledge of soil mechanics and geotechnical structural design.
- Elementary knowledge in design/construction of excavation pits.

Target group

- Students
- Professionals
- Managers
- Designers, geotechnical or site engineers with interest in solving of urban excavation problems

Learning objectives

- Learning the engineering techniques required for successful design of excavation pits in an urban environment.
- Introduction to advanced modelling for research purposes.
- Lessons learned from real projects
- Understanding challenges and need for innovations.

Teacher

Zlatko Dzanic
University of Sarajevo

LANDSLIDES IN HIGHWAY CONSTRUCTION

Course Description

Highways constructed in landslides demand a very special concept of design. Geotechnical/Civil engineers should have the skills to recognize the landslide-related problem and to prepare the practical solution at the preliminary and main design stage. Understanding landslide mechanisms, as well as landslide-structure interaction, is very important for the reduction of landslide-related risks.

Course Content

- Nature and landslides in BiH
- Landslide mechanism
- Construction of highways in landslide areas
- Concept of Retaining structures in landslides
- Importance of drainage in landslides
- Numerical and limit equilibrium analyses of landslide related problems
- Case studies

Pre-requisites

- Basic geostatic analysis

Target group

- Students
- Professionals
- Managers

Learning objectives

- Understanding the Nature and Landslides mechanisms typical for Bosnia and Herzegovina.
- Importance of investigation works, monitoring, and observational methods for prediction of slope failures.
- Learning lessons from practical case studies (successfully applied measures and failures).
- Understanding the principles of simplified and advanced numerical modelling techniques of geotechnical structures interacting with landslides.

Teacher

Adis Skejić
University of Sarajevo

EARTHQUAKE ENGINEERING

SEISMIC DESIGN FOR ARCHITECTS

Course Description

Structure, is an indispensable architectural element imbued with the possibility of enhancing architectural functions and qualities, and if structure is to play architectural roles other than load bearing, its design cannot be left to just anybody. An architect should have the skills to conceive the structural configuration at the preliminary design stage, which not only satisfies programmatic requirements and his or her design ideas, but also is structurally sound with respect to seismic forces. The seismic codes say nothing about seismic design, which is the act of conceiving a strategy for the reduction of seismic risk and the structural/architectural systems that will accomplish it.

Course Content

- Earthquakes and ground shaking
- How buildings resist earthquakes
- Seismic design philosophy
- Structure
- Vertical
- Horizontal
- Irregularity
- Vertical
- Horizontal
- Non-structural elements

Pre-requisites

- Basic static analysis

Target group

- This course is intended to provide the means by which the architect (with considerable diligence) can acquire these skills.

Learning objectives

- Clear understanding of terms seismic design
- Understanding of seismic action and the way structures resist it
- Awareness of different behaviour of the structure under vertical and horizontal loads
- Knowledge of basic structural systems for resistance of seismic action
- Awareness of concept of regularity/irregularity of the structural system
- Understanding of basic types of horizontal and vertical irregularities and strategies to overcome them

Teacher

Elena Dumova-Jovanoska
Simona Bogoevska
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

SEISMIC DESIGN - EUROCODE 8

Course Description

The course focuses on providing basic understanding of the concept and philosophy of seismic design according to EN 1998. It will guide interested students to cover fundamentals on application of the Eurocode 8 provisions for buildings. It will provide necessary literature and solved examples to support the process of learning and EC8-based analysis of buildings for seismic loads.

Course Content

- Scope of EN 1998
- Performance requirements and compliance criteria
- Ground conditions and seismic action
- Design of buildings
- Characteristics of earthquake resistant buildings
- Criteria for structural regularity
- Structural analysis
- Linear static analysis
- Spectral modal analysis
- Non-linear static analysis (push-over)
- Nonlinear dynamic analysis
- Safety verifications
- Ultimate limit state
- Damage limitation

Pre-requisites

- Static and dynamic analysis
- Seismic design of structures
- Basic knowledge of Eurocodes

Target group

- Master students of Structural Engineering
- Practicing structural engineers

Learning objectives

- Clear understanding of EC8 seismic design philosophy
- Understand the concept of ductility classes
- Be able to define and use design spectrum
- Understand four types of seismic analysis (two linear and two non-linear)
- Be able to use two linear types of analysis
- Understand the concept of capacity design and safety verification

Teacher

Elena Dumova-Jovanoska
Simona Bogoevska
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

SEISMIC RESISTANT DESIGN

Course Description

This course provides knowledge about Seismic Resistant Design. In the Introduction, examples and discussion of damages due to the earthquakes are explained, as wee as basic seismological terms. Students will learn about response spectra, elastic and design acceleration spectra. Ductility and capacity, energy dissipation, behaviour factor.

- Earthquake resistant design of buildings. Regular design according to EC8. Structural systems: frames, walls, masonry structures. Design of buildings, global layout of building in plan, layout in height, foundations, joints.
- Seismic analysis methods. Structural modelling. Static and dynamic analysis, linear and nonlinear approach.
- Capacity design. Basic principles, plastic mechanism, capacity of structural elements, shear forces in capacity design. Structural design and detailing with emphasis on reinforced concrete structures.

Course Content

- Engineering tools – design spectra
- Concept of regular earthquake resistant design
- Capacity design method
- Design solutions

Pre-requisites

- Static and dynamic analysis
- Seismic design of structures
- Basic knowledge of Eurocodes

Target group

- Master students of Structural Engineering
- Practicing structural engineers

Learning objectives

- Understanding and application of generally accepted seismic safety concept and rules for earthquake resistant design of buildings in accordance with modern technical codes and state of knowledge.
- Capability to develop regular structural system of building and to perform contemporary seismic analysis.
- Application of capacity design approach.
- Competences for seismic evaluation of building and retrofit of structures.

Teacher

Mustafa Hrasnica
University of Sarajevo

RECONSTRUCTION OF BUILDINGS AND THEIR EARTHQUAKE RESISTANCE

Course Description

The course "Reconstruction of buildings and their earthquake resistance" provides students with knowledge about what are strength and deformation properties of concrete and masonry, how to test them for an existing building, types of reconstruction, explanation the analysis of reinforced concrete and masonry buildings (examples).

Course Content

- Lectures on strength and deformation properties of concrete and masonry
- Lectures on reinforced concrete and masonry buildings
- Field testing of concrete and masonry
- Estimation the effectiveness of reconstruction (examples)

Pre-requisites

- Static and dynamic analysis
- Seismic design of structures
- Basic knowledge of Eurocodes

Target group

- Master students of Structural Engineering
- Practicing structural engineers

Learning objectives

- Practice skills in estimation of concrete and masonry properties using non-destructive methods and estimation the effectiveness of reconstruction.

Teacher

Hovhaness Avagyan
National University Architecture and Construction of Armenia

SEISMIC VULNERABILITY OF BUILDINGS

Course Description

The determination of seismic risk is the foundation for risk mitigation decision-making, a key step in risk management. The formulation of an earthquake loss model for a given region is of importance for risk mitigation. Furthermore, the loss model can be used to design retrofitting schemes by carrying out cost/benefit studies for different types of structural intervention schemes. A significant component of a loss model is a methodology to assess the vulnerability of the built environment. The seismic vulnerability of a structure can be described as its susceptibility to damage by ground shaking of a given intensity. The various methods for vulnerability assessment can be divided into two main categories: empirical or analytical, both of which can be used in hybrid methods. The most wider used methods are presented in this course.

Course Content

- Assessing and managing earthquake risk.
- Overview on earthquake hazard assessment
- Observation, characterization and prediction of strong ground motion
- Overview on earthquake risk assessment
- Vulnerability assessment of buildings
- Empirical methods
- Analytical methods

Pre-requisites

- Static and dynamic analysis
- Basic concepts of probability

Target group

- Master students of Structural Engineering
- Practicing structural engineers

Learning objectives

- Clear understanding of terms; seismic hazard, seismic vulnerability and seismic risk
- Awareness of different approaches for definition of seismic hazard
- Understanding of different approaches for definition of vulnerability
- Be able to use available Damage Probability Matrices and Vulnerability Curves
- Be able to define steps in analytical procedure for definition of vulnerability functions

Teacher

Elena Dumova-Jovanoska
Kristina Milkova
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

STRUCTURAL MATERIALS AND ENGINEERING

AN INTRODUCTION TO (SENSORY-BASED) STRUCTURAL IDENTIFICATION

Course Description

The course guides students through four topics which provide an essential understanding of the field of monitoring-based structural identification. In this context, the course material covers the basic concepts of structural health monitoring and output only analysis. Furthermore, sections two and three deliver fundamental knowledge regarding modal analysis and signal analysis. The final part gives a brief theoretical overview and conceptual outlook of most commonly applied structural identification methods in the field of civil engineering.

Course Content

- Sensory-based structural identification: introduction & concept
- Modal analysis in civil engineering: what it is & why do we need it
- Signal analysis: fundamentals & mathematical transformations
- Structural identification: fundamentals & application of basic methods

Pre-requisites

- Basic knowledge of dynamic analysis
- Basic knowledge of coding languages

Target group

- Master students of Structural Engineering
- Practicing structural engineers

Learning objectives

- The student will get initial experience in producing useful outputs from gathered sensory information from operational structures. Consequently, the student will develop a primary understanding of the field and concept of structural health monitoring applied in the area of civil engineering.
- The student will become equipped with fundamental skills and knowledge for recognizing healthy data, as well as for carrying out simple signal analysis of collected time-history data.
- The student will increase knowledge about structural dynamics in modal domain, and will be able to understand and apply simple structural identification methods for modal identification of civil engineering structures.

Teacher

Simona Bogoevska
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS (CFD) FOR ENVIRONMENTAL FLOWS

Course Description

The first part focuses on the fundamental theoretical basics to describe incompressible fluids and flows. The theoretical background is applied to a variety of related practical engineering challenges to recapitulate and deepen the student's understanding and to find adept solution procedures. The second part discusses the computational aspects of fluid dynamics and focuses on the fundamental theoretical basics. In this part, the students are introduced to all stages of a CFD simulation from the implementation of complex geometries and numerical meshes to critically assess the results.

Course Content

- Hydrostatics and kinematics
- Conservation principles
- Turbulent flows and boundary layer flow
- Guided Exercise: pipe flows, dissipation
- Spectral analysis of turbulent flows
- Introduction, engineering applications,
- Meshing, Navier-Stokes equations
- Simulations types, turbulence modelling
- Boundary conditions, discretization methods
- Solving the NS equations, errors, validation, verification

Pre-requisites

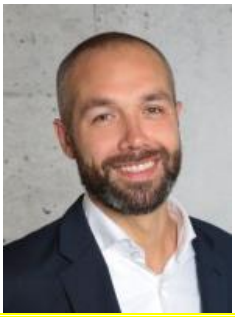
- Fundamentals of mechanics and mathematics.

Target group

- Students
- Engineers

Learning objectives

- Determine hydrostatic pressure distributions on arbitrary objects.
- Apply the mass conservation principles for flow velocity prediction in pipe systems.
- Calculate flow induced forces by use of the conservation of momentum equation.
- Conduct spectral analyses of turbulent flows
- Apply requirements to create high quality numerical meshes for complex geometries.
- Assess results of numerical CFD simulations by error estimation, validation, and verification techniques.



Teacher

Rüdiger Höffer
Ulf Winkelmann
Ruhr University Bochum

TESTING OF STRUCTURES

Course Description

The real behaviour of structures under loading in many times is possible to determine only by testing. Therefore, all buildings of high importance before exploitation are tested in order to examine all assumptions used in the design. This course covers the basic of measurements, determination of strains and stresses in real structures by using different methods and techniques of testing.

Course Content

- Structural testing – overview, basics of structural systems, material behaviour, material idealization, structuran modelling.
- Measurement and measuring instruments, laboratory and field testing.
- The purpose of experimental measuring of deformations and stresses in load bearing.
- Experimental measurement of deformations, displacements and stress states at selected points of engineering structure and interpretation of results.
- Determination of static and dynamic structural characteristics.
- Monitoring of the real behaviour of engineering structures.

Pre-requisites

- Basics of statics and dynamics of structures.
- Knowledge in material behaviour

Target group

- All structural engineers who are in some way involved in the design and monitoring of structures.

Learning objectives

- Clear understanding of terms structural testing
- Understanding of structural behaviour under loads
- Implementation of basic testing methods and techniques
- Critical analysis of the testing results

Teacher

Goran Simonović
Civil Engineering Faculty University of Sarajevo

SUSTAINABILITY OF THE BUILDING

Course Description

The course introduces student to the concept of sustainability of the buildings giving overview of the concept of the sustainability, sustainability in construction, life building cycle, service life, methods like life cycle assessment, durability and condition building assessment.

Sustainability is of crucial importance today and this course is designed with the aim of rising awareness among young engineers about connections between each step in building process – from design over construction and maintenance to possible reuse.

Course also presents importance and advantages of use of IT software's and BIM methodology.

Course Content

- Sustainability
- LCA
- Durability
- Service life
- Condition building assessment
- BIM

Pre-requisites

- Basic knowledge of building processes

Target group

- Students
- Young professionals

Learning objectives

- Clear understanding of concept of sustainability and sustainability in construction
- Understanding of the links between sustainability – durability – condition assessment - maintenance
- Awareness of importance of durability and maintenance at the early designing stage
- Wider understanding of building processes and their effects on environment, economy, safety and health.

Teachers

Merima Šahinagić-Isović
Amra Šarančić Logo
Faculty of Civil Engineering, Dzemal Bijedic University of Mostar

ENERGY EFFICIENCY IN SUSTAINABLE BUILDINGS

Course Description

This course is designed to meet the needs of current architects, engineers, project managers or other design professionals who want to pursue further professional development in the construction environment.

Course Content

- Sources of energy
- Renewable sources of energy
- Design principles
- Building Orientation
- Shading
- Daylighting
- Green Roofs
- Thermal comfort and buildings
- Insulation and the building envelope
- Building-envelope systems and their insulation
- Roofs
- Openings
- Building-integrated photovoltaic
- The smart building evolution
- Strengthening the link between the real and the digital world
- Embedded Systems Software
- Structure of embedded systems
- Renewable Energy House Plan
- Future of energy

Pre-requisites

- The Basics Explained

Target group

- This course is intended to provide the means by which the specialist (with considerable diligence) can acquire these skills.

Learning objectives

- Analyse, synthesise and apply sustainable building theory and principles to address industry issues, and implement new directions in sustainable building design
- Employ your knowledge of sustainable building and performance theory, and leading technologies, to develop solutions that respond to the diverse needs of sustainable building project stakeholders
- Work autonomously and utilise effective teamwork to plan sustainable building projects, responsive to the needs of diverse stakeholders.

Teachers

Anna Grigoryan
National University Architecture and Construction of Armenia**,** Yerevan, Armenia.

DURABILITY OF CONCRETE STRUCTURES

Course Description

The course introduces you to the deterioration mechanisms of concrete material under different environmental actions including carbonation, chloride ingress, freeze-thaw cycles, leaching, salt crystallization, sulphate corrosion (mechanisms, influential factors and models) and their influence on steel corrosion.

Course Content

- Mechanisms of concrete deterioration
- Carbonation and induced steel corrosion; Chloride ingress and induced steel corrosion; Freeze-Thaw Damage; Leaching; Salt crystallization; Sulphate corrosion
- Loading and cracking; multi-fields problems; drying wetting actions
- Durability design of concrete structures
- Approaches and methods.
- Inspection of concrete structures
- Laboratory and in-situ methods.
- Maintenance and repair of concrete structures (according to EN1504).

Pre-requisites

- None

Target group

- Students
- Professionals
- Managers

Learning objectives

- Detailed understanding of typical deterioration mechanisms and controlling parameters
- Basic understanding of methods for inspection of concrete structures
- Basic understanding of methods for maintenance and repair of concrete structures
- Learn how to plan an inspection of a typical reinforced concrete structure
- Learn how to undertake (non-structural) assessment of a typical concrete structure
- Learn how to propose mitigating measures and repair strategies.

Teacher

Toni Arangelovski
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

STRUCTURAL DESIGN WITH FRP MATERIALS

Course Description

FRP composite materials represent a new class of materials with great potential for application in engineering structures. A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used alone. The main advantages of composite materials are their high strength and stiffness, combined with low density, when compared with bulk materials, allowing for a weight reduction in the finished part. The objective of this course is to provide an integral overview of the characteristics of composite FRP materials, their mechanical behaviour, approaches for analysis and mathematical modelling, as well as the procedures used for design of structures using FRP materials.

Course Content

- Overview of FRP composite materials
- Properties of constituent materials - reinforcing fibres and matrix
- Micromechanics of composite materials
- Constitutive relations for orthotropic materials. Laminate theory
- Design basis for FRP Strengthening. Flexural and shear strengthening. FRP Confining
- Design concepts for FRP profiles and all FRP structures.

Pre-requisites

- Mechanic of materials
- Fundamentals of Structural design

Target group

- Graduated engineering students:
- Structural engineering
- Mechanical engineering
- Architecture
- Practical engineers/professionals

Learning objectives

- Select a proper FRP material for specific structural application
- Define material characteristics necessary for structural design with FRP materials
- Perform structural analysis and interpret the obtained results from analysis
- Design of simple structural elements made of FRP composite materials

Teacher

Koce Todorov
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

SUSTAINABLE NEW BUILDING MATERIALS

Course Description

The course explains terms sustainability and sustainable development, which includes a number of aspects such as cultural and socio-economic aspects, structural design of buildings, new environmental friendly and durable materials and the life cycle of buildings. All stated starts with sustainable new materials. It is very important to plan from the start and build sustainable building materials into the initial design that can provide durability and easier maintenance of the structures, mainly housing and public buildings. In addition, sustainable new materials can lead to cleaner environment since they are consuming resources considered as waste.

Course Content

- Meaning and possibilities of sustainability in materials and constructions
- New and sustainable new materials in construction
- Presentation of best practices and possible applications in our environment
- Need for mind shift in building design, construction and maintenance.

Pre-requisites

- Basic knowledge of construction materials

Target group

- Students
- Young professionals

Learning objectives

- Clear understanding of performances of the sustainable materials, their use and possibilities in construction industry as well as maintenance requirements,
- Ability to describe and discuss proper installation of building materials and their effectiveness in interior and exterior application
- Wider understanding of use of sustainable materials and their effects on sustainability of the building, environment and investment

Teacher

Merima Šahinagić-Isović
Faculty of Civil Engineering, Dzemal Bijedic University of Mostar
Marko Ćećez
Faculty of Civil Engineering, Dzemal Bijedic University of Mostar

DESIGN OF CONCRETE STRUCTURES TO EC2

Course Description

The course introduces the basic principles in EC2 (EN 1992-1-1:2004) and relationship to other Eurocodes and European standards. It will provide overview of the content in EC2, regarding: Materials, Durability and Structural analysis. Design procedures at the ultimate limit states will be explained (bending without and with axial loading, shear and torsion) and serviceability limit states (stress, crack widths and deflection).

Course Content

- Introduction to EC2
- Basis of design
- Combinations of actions
- Materials
- Durability
- Structural analysis
- Ultimate limit states
- Serviceability limit states.

Pre-requisites

- No pre-requisites

Target group

- Students at bachelor/master studies and engineers

Learning objectives

- Basic understanding of the background of EC2 for structural design,
- Understand the content of EC2 and be able to apply it for design of concrete structures,
- Establish combinations of loadings on concrete structures using partial factors,
- Ability to explain characteristic material strengths of structural concrete and partial factors,
- Establish the design procedure for structural phenomena on reinforced concrete at ultimate limit states and serviceability limit states.

Teacher

Darko Nakov
Civil Engineering Faculty “Ss. Cyril and Methodius” University, Skopje

MODELLING OF MASONRY STRUCTURES

Course Description

The course "Modelling of masonry structures" provides students with knowledge about computational mechanics and real-life structures. After completing the course students will be able to conduct experimental testing and computational modelling of masonry: wallets, in-plane response of solid brick masonry walls, strengthening of masonry, framed masonry for reversed horizontal loads, influence of wall openings

Course Content

- Introduction to finite element method.
- Experimental testing and computational modelling of masonry: wallets, in-plane response of solid brick masonry walls, strengthening of masonry, framed masonry for reversed horizontal loads, influence of wall openings.
- Macro-models
- Meso-models

Pre-requisites

- Basic knowledge of theory of structures
- Elementary experience with finite element programs (any kind)

Target group

- Students: Master & PhD
- Structural engineers from industry with interest in modelling of structures

Learning objectives

- Mastering numerical modelling of engineering structures using commercial solvers.
- Bridging the gap - theoretical knowledge, experimental (DIC) and numerical Modelling
- Introduction to advanced modelling for research purposes.

Teacher

Senad Medić
University of Sarajevo

FINITE ELEMENT ANALYSIS OF REINFORCED CONCRETE AND MASONRY STRUCTURES

Course Description

The course "Finite element analysis of reinforced concrete and masonry structures" provides students with knowledge about computational mechanics and real-life structures. After completing the course students will be able to use computer software by relating to real-life structures (SAP2000, TOWER) and conduct advanced numerical modelling employing DIANAFEA.

Course Content

- Introduction to finite element method and examples of MATLAB application.
- Analysis of day-to-day reinforced concrete structures using SAP2000 and TOWER: beams, walls, slabs, discontinuities, foundations.
- Moment – curvature relations and nonlinear analysis of RC frame.
- Experimental testing and computational modelling utilizing DIANAFEA: shear failure of beams and slabs under concentrated forces, slender RC walls and beams exposed to cyclic loading, behaviour of concrete structures under elevated temperatures.
- Meso- and macro-models for masonry: wallets, in-plane response of solid brick masonry walls and framed masonry for reversed horizontal loads.

Pre-requisites

- Basic knowledge of theory of structures
- Elementary experience with finite element programs

Target group

- Students
- Young professionals
- Structural engineers from industry with interest in modelling of structures

Learning objectives

- Mastering numerical modelling of engineering structures using commercial solvers.
- Bridging the gap - theoretical knowledge, experimental (DIC) and numerical modelling
- Introduction to advanced modelling for research purposes.

Teacher

Senad Medić
University of Sarajevo

EN1992-1-1 CONCRETE DESIGN USING STRUT AND TIE (SAT)

Course Description

Strut and tie model can be developed for whole structural structure, structural elements, regions of elements, and even structural detailing. Usually starting point is trajectories of principal elastic stresses. Having in mind that in reinforced concrete elements tensile forces follow the reinforcement, and that tensile stresses in concrete causes cracking and plastic deformation followed by constant redistribution of internal forces it is reasonable to simplify trajectories to make them comply with specific requirements of reinforced concrete elements. Strut and tie model will give complete insight in the flow of the internal forces from the area of their application throughout the element until they are finally rested at the supports, so it minimises possibility of engineering mistakes.

Course Content

- Strut and tie modelling – principles and methodology
- Corbels
- Half joints
- Deep beams
- Indirect supports and indirectly supported elements.

Pre-requisites

- Basic knowledge of the theory of elasticity and reinforced concrete design

Target group

- This course is intended to provide the means by which the civil engineers can understand logic behind strut-and-tie analysis and create own strut and tie model.

Learning objectives

- Understanding of basic concepts and logic behind strut-and-tie modelling.
- Awareness of what type of problems can be solved by strut-and-tie modelling.
- Knowledge of how to create own strut and tie model by basic theoretical considerations and some worked examples.
- Knowledge of the way the strut and tie analysis is mentioned in EC2.

Teacher

Armin Hadrović
Faculty of Civil Engineering, Dzemal Bijedic University of Mostar

ORGANIZATION OF CONSTRUCTION MONITORING

Course Description

This course basic explains the application of automatic monitoring system methods that employ portable data loggers and wired and wireless systems. In addition, we outline the structure of these connection methods. The application of these methods considers the distance between the office and construction sites and conditions such as underground work, weather, and the number of workers. Additionally, appropriate measuring sensors, are installed in construction sites according to the characteristics of the given construction project. We herein use a case study to explain the operation of CSD and IMS programs.

Course Content

- Collection static data (CSD)
- Integration measuring system (IMS)
- Comparison between existing monitoring and automated monitoring system.
- Integration of Information Services.
- Building Management Systems (BMS).

Pre-requisites

- The Basics Explained

Target group

- This course is intended to provide the means by which the specialist (with considerable diligence) can acquire these skills.

Learning objectives

- Monitoring System Application.
- Integrated technological building systems, communications and controls to create a building.
- Knowledge of monitoring equipment, such as a continuous analyser, and measuring instruments, such as the EL-beam, cracking test machines, and vibration measuring devices for operating automated monitoring systems.

Lecturer

Azat Smbatyan
National University Architecture and Construction of Armenia, Yerevan, Armenia.

IT & SOFTWARE

IOT - INNOVATION SYSTEMS

Course Description

The Innovation Systems/IoT discipline covers the research activities in the field of smart systems, innovations, and computing, discusses smart IOT systems and the challenges, reviews the different computational aspects of various engineering domains, such as complex security solutions for networks, forensics, and parallel computing.

Course Content

- Things and Connections
- Sensors, Actuators, and Microcontrollers
- Programming
- Networks, Fog and Cloud Computing
- Connecting Things to the Network
- The IoT System
- Industrial IoT Applications
- Create an IoT System

Pre-requisites

- The Basics Explained

Target group

- This course is intended to provide the means by which the specialist (with considerable diligence) can acquire these skills.

Learning objectives

- Describe what IoT is and how it works
- Design and program IoT devices
- Use real IoT protocols for communication
- Secure the elements of an IoT device
- Transfer IoT data to the cloud and in between cloud providers
- Define the infrastructure for supporting IoT deployments

Teacher

Ruzanna Sargsyan
National University Architecture and Construction of Armenia

CLOUD TOOLS TO ENSURE THE QUALITY OF RESEARCH AND EDUCATION

Course Description

The course covers current advances in the use of cloud-based tools for research and education. Special attention is paid to the practical study of popular suits of office and educational tools that can also be effectively used in research.

Course Content

- Introduction to Cloud Technologies and Tools
- Analysis of Typical Situations in Research and Education
- Microsoft Office 365 for Education
- Google for Education
- Other Cloud Applications

Pre-requisites

- No previous knowledge or experience

Target group

- For the general public

Learning objectives

- Discover a new world with a lot of possibilities, a cloudy environment, where using of free, safety tools supported educational and research activates is possible from any equipment, at any time and in any place.
- Increase awareness and develop skills of effective use powerful sets of cloud tools in research and education.
- Identify and configure the proper cloud tools for specific tasks and fields of activity.

Teacher

Hasmik Markosyan
National Polytechnic University of Armenia

DATA DRIVEN DECISION MAKING

Course Description

The course is an introduction to the concept of Data Analytics, the difference between structured, unstructured, and semi-structured data. Why do we need a data and analytics framework? What analytic techniques and tools it will be good to use. The lesson, furthermore, will address the issues and emerging trends in big data analytics and will describe how visualization is important to data and analytics. Going through the modules, the learner will develop an understanding of the solving problems using data analytics and make better and faster decisions.

Course Content

- Introduction to Data Analytics.
- Using Data to Make Decisions.
- Types of data. Big data and its impact on business.
- The different types of tools and technologies used to gather data.
- Data analysis techniques.

Pre-requisites

- No previous knowledge or experience

Target group

- For the general public with special emphasis on young researchers and teachers

Learning objectives

- Get introduced to a concept of big data and the basics of data analytics where learners will know about different types of data and the value data analytics brings to decision-making processes.
- Use a variety of data tools and technologies for organizing and analysing information about process performance.
- Be equipped with relevant skills that will allow learners to develop new processes based on data or learn how to use data to increase productivity and make well-informed decisions.

Teacher

Kristina Khudaverdyan
National Polytechnic University of Armenia

MOBILE PROGRAMMING AND CLOUD APPLICATIONS

Course Description

This course is an introduction of mobile programming, where we will get acquainted with the main aspects and features of programming for mobile devices. It provides an overview of App Design Issues and Consideration, describes the differences between iOS and Android devices that impact the design. The course concludes with an introduction to powerful tools for students and educators, which will give them the support they need so they can create a secure and collaborative learning environment on mobile platforms.

Course Content

- Development of Mobile Programming
- App Design Issues and Considerations
- Development of Cloud Mobile Applications
- Microsoft Office 365 for Education on Mobile platforms
- Google for Education on Mobile platforms
- Other Mobile Applications.

Pre-requisites

- No previous knowledge or experience

Target group

- For the general public with special emphasis on young researchers and teachers

Learning objectives

- Use the basic knowledge and practical skills in software development for mobile devices.
- Get acquainted with the features of the development of mobile applications.
- Use cloud technology for mobile app development.
- Find strategies, resources and technological tools, which will help the to quickly create online classes with new ways for cooperation and learning.

Teacher

Ani Manukyan
National Polytechnic University of Armenia

OBJECT-ORIENTED AND INTERACTIVE PROGRAMMING IN PYTHON

Course Description

The course is an introduction to Object-oriented and Interactive Programming, and it covers what Python is, working with Python, the difference between a Compiler and an Interpreter, Python features and what the student can do with Python. The course introduces the two modes of Python: script and interactive. It will also help the student to create interactive applications with Python.

Course Content

- Introduction to Python
- Variables and Standard Data Types
- Python Collections
- Decision-making Statements and Loops
- Working with Functions/Modules and Files
- Object-oriented Programming in Python
- Interactive Programming in Python.

Pre-requisites

- No previous knowledge or experience

Target group

- For the general public with special emphasis on young researchers and teachers

Learning objectives

- Get introduced to Python as a popular, easy-to learn, high-level coding language.
- Be able to create some applications with the help of Python.
- Be equipped with the appropriate skills that will allow him to do System Programming, Internet Scripting, Component Integration with Python, etc.

Teacher

Kristine Hambardzumyan
National Polytechnic University of Armenia

SOFTWARE DESIGN AND TESTING

Course Description

The course covers bases of software design process, software technologies and design methodology. In the course introduce the fundamental concepts of software testing, software development models, test levels and test types. At the end of the course, students will be presented with the concepts of creating test-cases and bug-reports, which they will be able to apply in practice.

Course Content

- Software Design Concept
- Fundamentals of Testing
- Testing Throughout the Software Lifecycle
- Static and Dynamic Techniques
- Test-cases, Bug-reports

Pre-requisites

- No previous knowledge or experience

Target group

- For the general public with special emphasis on young researchers and teachers

Learning objectives

- Using technologies and methodology for software design
- Elaborate test cases,
- Handle document flaws and mistakes,
- Implement a partial and complete retesting,
- Conduct white and black box testing.

Teacher

Marine Usepyan
National Polytechnic University of Armenia

VIDEO CONTENT AS A TOOL FOR BLENDED LEARNING

Course Description

In this course, the usefulness and the applicability of the video in the context of the classroom will be discussed with practical examples. The course will explore the personal interests and barriers in using videos in flipped classrooms providing practical resources to overcome such barriers. Among other resources, the course will show a special Video Lecture Capture System, by using the special app/software. Furthermore, a similar methodology to produce small videos as support of classes or to be used in a flipped classroom context will be applied in the course. Finally, course will present the results of the impact of the use of videos upon students' motivation.

Course Content

- Developing educational videos for Blended Learning.
- Efficiency of using video materials from teacher and student point of view.
- Advantages and disadvantages of the video content.
- Video preparation methodology.
- Hardware and software requirements for video creating.
- Creating videos based on presentations, combined with existing video and audio

Pre-requisites

- No previous knowledge or experience

Target group

- For the general public with special emphasis on young researchers and teachers

Learning objectives

- Use a video in the context of blended learning as an effective media for delivering educational content.
- Discuss the advantages and disadvantages of the use of videos as support of classes/flipped classrooms.
- Create videos by using the special App/Software.
- Identify productive applications in their teaching and research practices.

Teacher

Ella Hovhannisyan
National Polytechnic University of Armenia

CYBER-SECURITY FOR NON-PROFESSIONAL

Course Description

The current course introduces contemporary cybersecurity threats, vulnerabilities attacks and security methods. The first part of the course describes Potential threats, attacks and existing security methods and tools. Shallow description of security methods and tools also is introduced.

The second part of the course describes applications of appropriate security tools and a group of operations which helps the user to secure himself/herself.

Course Content

- Introduction
- Structure of Computer Networks
- Cryptography
- Secure E-mail and Phishing attacks
- Antiviruses
- Firewall and VPN
- OWASP TOP 10
- Data Privacy and GDPR
- How to be Cyber Secure

Pre-requisites

- basic computer skills (Windows 7,10, Browsers, e-mail)

Target group

- Students
- employees

Learning objectives

- Clear understanding of possible cybersecurity threats and vulnerabilities
- Awareness of different cyber attacks
- Knowledge of basic actions which helps the user to secure himself/herself.
- Awareness of data privacy and GDPR rules
- Assessment of potential risks and mitigation of potential attacks.

Teacher

Sergey Abrahamyan
Institute for Informatics and Automation Problems of the National Academy of Sciences of the Republic of Armenia

ENGINEERING SOFTWARE TOOLS

CAD ORIENTED SOFTWARE

Course Description

This course is a partial-length AutoCAD 2018, 19 and 20 learning package which contains basic topics that the student will need to work with this software. The course is designed for a beginner as well as seasoned users. The course is intended for students with no prior knowledge of AutoCAD and working professionals looking to upgrade his/her skills and learn/strengthen the beginner topics in AutoCAD. The course introduces AutoCAD software for 2D drawing and design. The course describes the basic graphical elements and commands for drawing, dimensioning, using layers, symbols, blocks and attributes. The students will apply operations for acquiring data.

Course Content

- Introduction to AutoCAD for 2D drawing and design.
- Introduction to AutoCAD environment
- Drawing and modifying commands
- Zoom and selection commands
- Layers and layer property manager
- Dimensioning and text commands
- Inquiry commands
- Operations for acquiring data

Pre-requisites

- Basic technical drawing knowledge
- No previous experience in AutoCAD is needed
- Access to AutoCAD software (student, trial or commercial version) AutoCAD LT can be used as well.

Target group

- Beginner and seasoned users.
- Students with no prior knowledge of AutoCAD and
- Working professionals looking to upgrade his/her skills and learn/strengthen the beginner topics in AutoCAD

Learning objectives

- Learn most of the tools and commands with their real-world applications.
- Define, repeat and use the commands for drawing and solving the problems assigned.
- Apply the concept of creative thinking and find appropriate tools for problem-solving tasks.

Teacher

Sergey Churilov
Civil Engineering Faculty “Ss. Cyril and Methodius” University, Skopje

STRUCTURAL ANALYSIS WITH AUTODESK ROBOT STRUCTURAL ANALYSIS SOFTWARE

Course Description

This course is introductory Autodesk Robot Structural Analysis© (ARSA) software course which contains basic topics that the student will need to work with this software. The course is designed for a beginner user. The course is aimed for students with no prior knowledge of ARSA, architects, civil engineers and anyone related to the calculation and design of structures. This course will cover the use of the ARSA software for modelling and calculation of buildings. The students need to have access to ARSA software (student, trial or commercial version) for this course. The students should already be familiar with the theoretical aspects of the calculation of structures.

Course Content

- Introduction and software overview
- Creating the geometric and analytical model
- Application of loads
- Types of analyses and performing static and modal analyses
- Analysis results and post processing

Pre-requisites

- Theoretical aspects of structural analysis and FEM
- Access to ARSA software (student, trial or commercial version

Target group

- Students with no prior knowledge of ARSA
- Architects
- Structural and Civil engineers
- Anyone related to the calculation and design of structures

Learning objectives

- Learn most of the tools and commands necessary to prepare calculation model and run the structural analysis.
- Use the creation tools of the structure (beams, column, slabs, walls) and be able to apply the structural loads.
- Acquire general knowledge to perform static and modal analysis. Several important modal analysis parameters will be highlighted in order to indicate their performance and importance when conducting the analysis.

Teacher

Sergey Churilov
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

INTRODUCTION TO PROGRAMMING FOR ENGINEERING RESEARCH AND PRACTICE

Course Description

The goal of this course is to introduce students to engineering problem solving using a modern computational environment. In the context of engineering applications, basic procedural programming concepts will be covered including input/output, branching, looping, functions, file input/output, and data structures such as arrays and structures. Additionally, the course will introduce numerical methods such as curve fitting. The course enables introduction to the use of programming languages in the analysis of scientific and practical problems in engineering.

Course Content

- Introduction
- Basics of MATLAB/Octave
- Fundamentals of MATLAB/Octave Programming
- Flow Control
- Vectorization

Pre-requisites

- None

Target group

- This course is aimed at anyone who would like to take first steps into programming

Learning objectives

- Apply the principles of algorithmic thinking and programming
- Acquire knowledge of basic procedural programming concepts
- Become proficient in the use of a modern computational tool.
- Implement simple computer programs.
- Develop experience in specifying and designing a solution to an engineering problem using a software tool
- Extend and adapt code written by other programmers.

Teacher

Vladimir Vitanov
Civil Engineering Faculty "Ss. Cyril and Methodius" University, Skopje

BIM BASICS

Course Description

The course is intended to provide learners with fundamental understanding of Building Information Modelling (BIM) and its role in construction sector. The course focuses on the basic terms, principles, standards, procedures and workflows in BIM, as well as roles of various stakeholders, pointing out benefits of application of BIM compared to traditional method of delivery. The course is intended for all professional profiles in AEC sector.

Course Content

- Definition of BIM
- Key term and definitions BIM as a method of work
- BIM workflow
- BIM maturity levels and BIM dimensions
- Advantages of BIM
- BIM and sustainable construction
- BIM barriers and standards
- BIM requirements
- BIM software

Pre-requisites

- None

Target group

- This course is intended for students and professionals

Learning objectives

- Explain key terms and definitions within BIM
- Identify relevant standards
- Define BIM dimensions and BIM maturity levels
- Explain principles of workflow in BIM
- Define roles of participant in construction sector in BIM working environment
- Summarize benefits of BIM compared to traditional methods of work in construction sector
- Explain impacts of BIM on sustainable construction
- Summarize advantages of BIM for improved energy efficiency of buildings.

Teacher

Dijana Likar
Civil Engineering Institute MACEDONIA

INTRODUCTION TO USE OF BIM FOR IMPROVED ENERGY EFFICIENCY OF BUILDINGS

Course Description

The course is intended to provide learners with advanced knowledge on use of BIM as a digital tool to improve energy efficiency of buildings throughout their life cycle. Learners will be introduced with concepts of energy consumption in buildings and energy and cost life cycle assessment. Basic definitions associated to energy values and variables are included in the unit. Learners will be provided definitions and explanations of basic classification of energy efficient buildings, based on European commonly used codes. Methodology of energy balance based on BIM model will be explained. Advantages of BIM to traditional method of projects delivery will be demonstrated.

Course Content

- Concept & Definitions of Energy Use in Buildings
- Key Terms of Energy Use in Buildings
- Energy Usage During Construction and Operation of Buildings
- Building Fabric and Energy
- Heating and Ventilation System vs Energy Consumption
- Use of BIM Tools for Improved Energy Efficiency

Pre-requisites

- None

Target group

- This course is intended for students and professionals in AEC sector.

Learning objectives

- Explain principles of energy use in buildings.
- Specify relevant EU Policy and legislation in energy efficiency and energy performance of buildings
- Summarize the principles of energy balance of buildings
- Calculate required amount of operational energy of buildings
- Understand the impact of building envelope to energy consumption
- Explain principles of energy optimization in design and construction stage
- Explain methods for energy management and maintenance in operational stage of buildings
- Understand principles of Life Cycle Analysis and Life Cycle Energy Analysis
- Illustrate use of BIM tools for improved energy performance of buildings, in all stages of their life cycle.

Teacher

Dijana Likar
Civil Engineering Institute MACEDONIA

VIRTUAL REALITY VR SIMULATION AND DIGITAL MANUFACTURING

Course Description

The course "Virtual reality VR simulation and digital manufacturing" will provide students knowledge on how to design, analyse and interpret the results of computer simulation, as well as apply tools of stimulation in operations manufacturing management. The course has two parts. The first part covers general understanding of simulation methods and the second part include hands-on exercises and case examples.

Course Content

- Basics of Simulation
- Work library - Basics of Task Creation
- Introduction to Process Modelling
- Introduction to Layout Configuration

Pre-requisites

- None

Target group

- This course is intended for students and professionals

Learning objectives

- Develop computer simulation models of real or conceptual systems, and how to correctly design, analyse and interpret the results of computer simulation.
- Understand production simulation methods, tools and techniques.
- Apply tools of simulation in context of operations manufacturing management.
- Evaluate simulation model results.

Teachers

Petri Helo
Rayko Toshev
University of Vaasa

MANAGEMENT

RISK MANAGEMENT OF BUILT CULTURAL HERITAGE

Course Description

The course Risk management of built cultural heritage will provide students with knowledge about identifying the values of Cultural Heritage and its significance. In the frame of the course, the students will get acquainted with the Nara Grid as a method for valuing CH.

In order to make risk management, identifying the values of Cultural Heritage is very important. CH significance and integrity will be made by using the Nara Grid as method for valuing CH. Damaging mechanisms will be identifying by understanding threats based on "Risk management at heritage sites. The learners will analyse the case study of the Petra world heritage site" and "Ohrid world heritage site". Damage identification method will be introduced; as well as application of damage identification method to case study and application of damage mapping by completing missing items. Reporting on heritage values will be introduced; as well as reporting on damages and (possible) damaging mechanisms: threats, risks.

Course Content

- Identifying values of Cultural Heritage: significance and integrity;
- Nara Grid –method for valuing Cultural Heritage;
- Risk management at heritage sites;
- Damage identification method and damage mechanisms: threats and risks

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Determine and express the cultural heritage values of a historic building as the threats that jeopardize them;
- Use the Nara grid evaluation system for CH valuing and Risk assessment;
- Will learn to create Risk Management Plan at heritage sites and damage reporting;
- Will design a proper preservation strategy for the case study.

Teacher

Suzana Kasovska Georgieva
Institute for Research in Environment, Civil Engineering and Energy

MANAGING INTELLECTUAL CAPITAL

Course Description

The course is intended to provide learners with basic understanding of what intellectual capital is, and its importance for every organisation. During the course the learners will be able to explore different elements of intellectual capital, potential activities to grow these capitals and methods and indicators to measure and manage intellectual capital.

Course Content

- Building intelligent enterprises and systems
- Indicators and measuring intellectual capital
- Intellectual capital measurement and reporting: issues and challenges
- Managing intellectual capital (human capital, structural, organizational, process, innovation, customer capital)
- Sustainability for Competitive Advantage
- Developing collaborative innovative partnerships toward knowledge-based economy
- Managing intellectual capital toward competitive advantage and greater market value of the organization.

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Define the elements of intellectual capital
- Discuss on the importance of intellectual capital and its relation to competitive advantage of the company
- Discuss the benefits of collaborative and innovative partnerships
- Explore different methods for managing intellectual capital (human capital, structural, organisational, process, innovation, customer capital).

Teachers

Slavica Trajkovska
Institute for Research in Environment, Civil Engineering and Energy

Angelina Taneva-Veshoska
Institute for Research in Environment, Civil Engineering and Energy

CORPORATE SOCIAL RESPONSIBILITY

Course Description

Corporate Social Responsibility (CSR), Corporate Citizenship, Triple Bottom Line, and Sustainable Business have all become catchphrases for movements developing within corporations to address the very serious and growing vulnerabilities facing the world. CSR includes a company's social and environmental impacts as well as treatment of employees across its supply chain. Participants will learn how companies manage responsibility in their supply chain, how they monitor the related performance and what makes their sustainability reporting trustful and successful. A broad view to CSR in Europe and a specific method to install CSR in small-and medium sized enterprises will close the module. Both, the instrument and the method will encourage the participants, based on a theoretical framework, to enrich their business life with CSR.

Course Content

- Introduction to CSR
- The importance and origin of CSR
- CSR Reporting and communicating with stakeholders
- CSR in practice
- Managing and implementation of CSR (employees, ethical conduct & society, sustainable consumption and production, environment).

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Understand the roots of CSR
- Evaluate the concept of corporate social responsibility, and explore its relevance to ethical business activity
- Develop an awareness and understanding of ethical issues related to technology and innovation
- Understand the critical elements of a CSR initiative
- Understand the CSR communication paradox
- Understand the implementation issues of a CSR initiative
- Develop a strategic communication plan for CSR.

Teachers
Angelina Taneva-Veshoska
Institute for Research in Environment, Civil Engineering and Energy

Assistant
Ana-Tomikj
Institute for Research in Environment, Civil Engineering and Energy

ENTERPRISE RESOURCE PLANNING

Course Description

After the course the student will understand how ERP (Enterprise Resource Planning) systems are used in daily business and be able to analyse how ERP systems support business processes. The course will provide skills on how to do simple tasks with SAP system related to sales, manufacturing and purchasing. The course includes two parts. First one covers general understanding of simulation methods and the second part include hands-on exercises and case examples.

Course Content

- Navigation Course
- Sales and Distribution Case
- Materials Management Case
- Production Planning Case
- Financial Accounting Case
- Controlling Cost Center Case

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Understand ERP (Enterprise Resource Planning) and their implementation
- Analyse how ERP systems support business processes,
- Learn to do simple tasks with SAP system related to sales, manufacturing and purchasing.

Teacher

Petri Helo
Rayko Toshev
University of Vaasa

ENTREPRENEURSHIP FOR ENGINEERS

Course Description

This course provides an introduction to the business environment and particularly the role of the small to medium sized business. This course will motivate students to generate potentially commercial ideas from their engineering studies and provide knowledge how to evaluate this idea and package it as a product, process, service or concept in the form of a formal professional business plan.

Course Content

- Business environment
- Nature of enterprise
- Generation of potential business ideas
- How to package this knowledge in a professional, formal, realistic and professional business plan

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Identify opportunities
- Understand market forces
- Successfully commercialize new technologies
- Learn about the role of entrepreneurship in science, technology and engineering education
- Learn how to prepare a business plan

Teacher

Gohar Avetisyan
National University of Architecture and Construction of Armenia

ENGINEERING ETHICS

Course Description

The course is intended to provide learners with knowledge on importance of ethics in engineering, developing capabilities to differentiate personal vs. professional ethics, and examine ethical problems. The focus will be set on ethical principles, codes of ethics, correlation of solving ethical problems and engineering design.

Course Content

- Rights and responsibilities of engineers,
- Engineering standards,
- Passive and active responsibility,
- The distribution of responsibility in engineering,
- Problem of many hands in engineering,
- Factors affecting moral responsibility and degrees of responsibility, and
- Whistle-blowing.

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Understand the distinction between professional and personal ethics
- Recognize and describe the different forms of dishonesty that engineers may come across in practice
- Understand the similarities between ethical problem solving and engineering design
- Identify ethical issues at the different stages at the design process
- Understand what codes of ethics are
- Examine some codes of ethics of professional engineering societies
- Describe how engineering designs may affect the distribution of responsibility
- Analyse and evaluate the complex consequences and motives that typically attend moral issues in engineering practice
- Describe the problem of many hands and explain how it applies to engineering.

Teachers

Angelina Taneva-Veshoska
Institute for Research in Environment, Civil Engineering and Energy

MINDFULNESS FOR WELLBEING

Course Description

During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by following the instructions of the course. This course is engaging the participants in active learning, utilizing several techniques, such as experiments, discovery, mental models, problem solving, self-assessment quiz, personal diary, think-pair-share, misconception check, one-minute paper, 3-2-1, letter to my younger self, etc. With this course the participants will have opportunity to explore their lifestyle, approach to everyday situations and mindful practices, and challenge themselves to adopt effective methods for balanced life (private and business).

Course Content

- Mindfulness of body
- Mindfulness of mind
- Mindfulness of emotions
- Mindfulness of soul.

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Developing Communication and Interpersonal skills
- Developing Professionalism and Flexibility/adaptability
- Developing Conceptual/thinking skills: direct impact on Analytic thinking, indirect impact on Decision making
- Developing Business skills: direct impact on Creativity/innovation, indirect impact on Multicultural awareness, Care for sustainable development

Teachers

Angelina Taneva-Veshoska
Institute for Research in Environment, Civil Engineering and Energy

MARKETING MANAGEMENT FOR ENGINEERING MANAGERS

Course Description

The course is intended to provide learners with advanced knowledge on use of marketing management tools and methods. During the course participants will explore the benefits of marketing, different types of marketing and marketing management concepts.

Course Content

- The participants will be able to develop their marketing management skills, by analysing complex marketing challenges, choosing examples relevant to them (their own organisations or close organisations in their industry).
- The focus will be on current marketing management activities, as well as preparation for future, by discussing about marketing in the 21 century, options for innovation through marketing, PR and building and managing customer capital.

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Establish effective marketing strategy
- Recognise sustainable brands
- Use core marketing concepts to evaluate
- marketing scenarios
- Analyse and assess complex marketing challenges
- Develop an integrated marketing plan and concept
- Develop a comprehensive marketing analysis
- Establish marketing public relation strategy
- Manage customer capital in the organization.

Teacher

Kristina Antikj Georgievski
Civil Engineering Institute MACEDONIA

STRATEGIC MANAGEMENT

Course Description

The course Strategic Management is intended to provide learners with advanced knowledge on strategic management tools and methods. During the course participants will explore the benefits of strategic management, the difference between strategic planning and business planning and work on case studies.

Course Content

- Introduction to Strategic planning
- Levels of Strategic Management
- Environmental Scanning
- Strategy Formulation & Implementation
- Strategy Evaluation
- SWOT Analysis
- Case study: The importance of Strategic management

Pre-requisites

- None

Target group

- This course is intended for students and professionals.

Learning objectives

- Learn about the nature of strategic planning
- Learn how to write mission, vision and value statement
- Recognise the levels of strategic planning
- Learn about the stages of strategic management – strategy formulation, strategy implementation, strategy evaluation and strategic analytics, choice and implementation.
- Analyse environmental scanning (internal and external analysis)
- Work on case studies

Teacher

Gohar Avetisyan
National University of Architecture and Construction of Armenia

HISTORY OF ARCHITECTURE WITH SPECIAL ACCENT ON UNESCO HERITAGE SITES

Course Description

The course is intended to prepare participants with knowledge and skills to successfully handle CH values of architectural styles, CH valuing of UNESCO heritage sites and preservation strategies.

Course Content

- Architectural styles of Mediterranean and Middle East civilizations, Mesopotamia, Ancient Near East Egypt
- Values of UNESCO heritage sites
- Proper preservation strategies for UNESCO heritage sites
- Architectural styles of Classical period, Greco-Roman period
- Values of UNESCO heritage sites from Greco-Roman period
- Proper preservation strategies for UNESCO heritage sites from Greco-Roman period
- Architectural styles of Early and Middle Ages, Byzantium and Ottoman period
- Values of UNESCO heritage sites from Early and Middle Ages
- Proper preservation strategies for UNESCO heritage sites from Early and Middle Ages

Pre-requisites

- **None**

Target group

- This course is intended for students and professionals.

Learning objectives

- Determine and identify CH values of an architectural building
- Identify CH values of UNESCO heritage sites
- Create preservation strategies for UNESCO heritage sites

Teachers

Suzana Kasovska Georgieva
Institute for Research in Environment, Civil Engineering and Energy

INNOVATIVE PRACTICES

MASTER MINDFULNESS WITH GAME-BASED LEARNING

Description of the innovative teaching practice

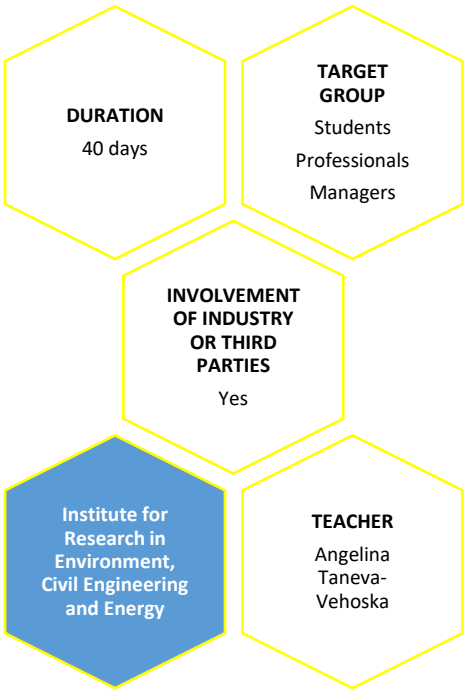
During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by playing the game Master Mindfulness. The game is engaging the participants in active learning, utilizing several techniques, such as experiments, discovery, mental models, problem solving, self-assessment quiz, personal diary, think-pair-share, misconception check, one-minute paper, 3-2-1, letter to my younger self, etc. In the game-based learning environment, the participants will work on accomplishing specific goal that they will set at the beginning of the practice, by choosing actions and experimenting along the way.

As participants will make progress and check specific achievements, they will earn badges and experience points. With this learning process the participants will have opportunity to explore their lifestyle, approach to everyday situations and mindful practices, and challenge themselves to adopt effective methods for balanced life (private and business).

The skills that they will develop/upgrade have transferability potential and can be used in situations at work, in private life. Also, the skills for mindfulness have direct and indirect impact on many other important skills.

Skills to be acquired/ improved:

- **Soft skills – people related skills**: direct impact on communication and interpersonal skills
- **Soft skills – personal skills:** direct impact on professionalism and flexibility/adaptability
- **Hard skills – conceptual/thinking skills:** direct impact on analytic thinking, indirect impact on decision making
- **Business skills:** direct impact on creativity/innovation, indirect impact on multicultural awareness, care for sustainable development



Methods and techniques

- Format - Game-based learning
- Techniques completed with individual work: experiments, self-assessment quiz
- Techniques completed in teams: problem solving, debate, demonstration.
- Available resources via e-learning platform: quests, articles, video materials, presentations, forum.

Methods for assessment and evaluation of the practice

Methods for assessment

- Pre- and post- self-assessment
- Points achieved in the game

Methods for evaluation

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase

SOLVING SUSTAINABILITY CHALLENGES WITH FRAME CREATION MODEL

Description of the innovative teaching practice

This innovative teaching practice collaborative learning, students work in teams on sustainability problems. The participants will have opportunity to explore new approach in solving open and complex everyday problems, using the unique frame creation model. The process will start with identification several relevant sustainability challenges with sessions where guest form industry and public institutions will be present. Though blended learning format the participants will understand the Frame creation model. Teams of 3-4 students will be made, working on realistic case study, developed from the identified sustainability challenges. The proposed solutions from each team will be presented at the end of this innovative teaching practice in a wider auditorium**.**

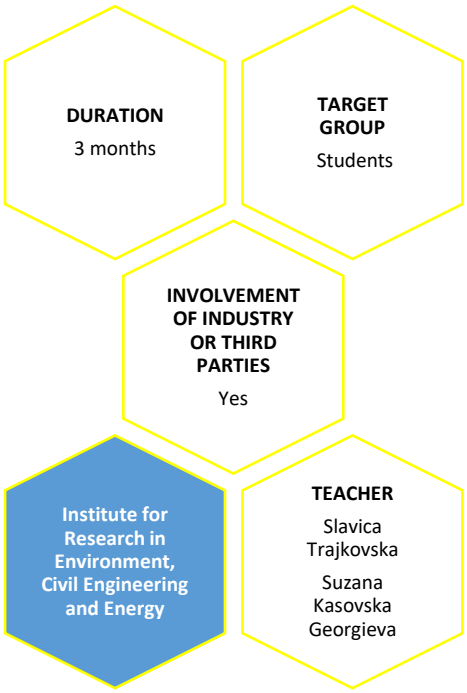
This innovative teaching practice is beneficial for students, because it offers methodology and transferrable skills that can be used in many different work and life situations.

The objective of the innovative practice:

- Solving real every day complex problems using Frame creation methodology
- Discovering new ways to view problems
- Archaeology — Deeply investigate the problem and earlier attempts to solve it
- Map the intellectual, cultural, and social ‘space’ that surrounds the problem
- Improve soft and hard skills

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills:** direct impact on Critical thinking, indirect impact on Decision making and Research and managing data
- **Soft skills – People related skills**: direct impact on Communication and Interpersonal skills
- **Soft skills – Personal skills:** direct impact on Flexibility/adaptability
- **Business skills:** direct impact on Creativity/innovation and Dealing with real world problems, indirect impact on Multicultural awareness and Global business



Methods and techniques

- Format - collaborative learning
- Techniques completed with individual work: self-assessment quiz
- Techniques completed in teams: case study, discussion forum, student presentations.
- Available resources via e-learning platform: articles, video materials, presentations, forum

Methods for assessment and evaluation of the practice

Methods for assessment

- Pre- and post- self-assessment
- Individual assignment
- Team presentations

Methods for evaluation

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase
- Feedback from involved professionals from industry and public institutions

CONSTRUCTION DEBRIS CHALLENGE

Description of the innovative teaching practice

The Construction Debris Challenge is a competition between teams of students, who will work on creating solutions for the given projects. Pair of two teams will work on solving the same problem, given by one construction company. It is expected to have 3-5 pairs of teams and 3-5 companies. Each team will have mentorship from academic staff and professionals from industry. At the finalization of the course a scheduled demo conference will take place, where participants present their work. The rest of the groups have to introduce questions and discussion on the presented topic.

The objective of the innovative practice:

- Visit a job-site to observe the dynamics of debris generation over many phases of construction
- Explore the availability of different strategies to tackle construction debris (recycling methods, sustainable production)
- Learn about green building materials and products

Topics that will be covered in this practice:

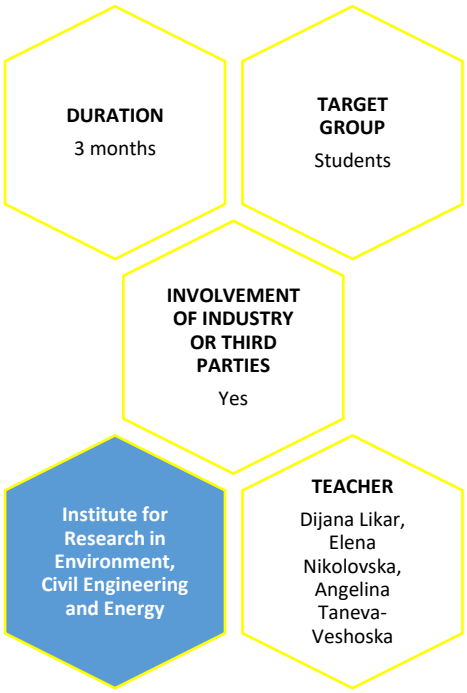
- The role of engineers in construction waste management
- Investigate construction debris production - Types and quantities of waste materials produced
- Cost savings accrued by recycling rather than disposing of waste in landfills
- Positive influence on the environmental impact of construction

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills:** direct impact on Critical and Analytical thinking, indirect impact on Planning and organising
- **Soft skills – People related skills:** direct impact on Collaboration and Communication
- **Soft skills – Personal skills:** direct impact on Social responsibility
- **Business skills:** direct impact on Strive for quality and Care for sustainable development

Methods and techniques

- Format – Student competition utilising project-based learning
- Techniques completed with individual work: discovery, self-assessment quiz
- Techniques completed in teams: brainstorming, discussion forum, challenging assumptions
- Available resources via e-learning platform: articles, video materials, presentations, forum



Methods for assessment and evaluation of the practice

Methods for assessment

- Team presentations
- Quality of proposed project

Methods for evaluation

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase
- Feedback from involved professionals from industry

"COLOUR ME GREEN" HACKATHON

Description of the innovative teaching practice

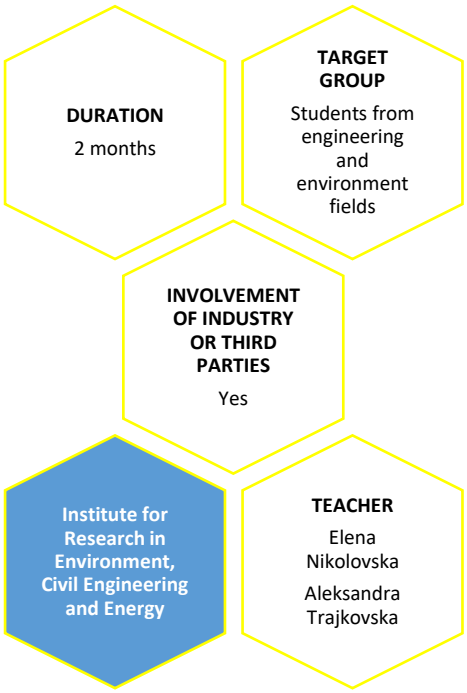
"Colour me green" Hackathon will be a design sprint-like event, including students form several fields: engineers, architects, graphic designers, environmental engineers, collaborating intensively on projects given by industry partners. The hacking will begin with project introductions by the Teachers and professionals from industry. They will explain what the students will work on at the very start of the event. Short training sessions will be organized on each day in duration up to 1,5 hours. At the end of the event, a wrap-up session will be organised so each team will present their project solutions. A panel of judges (Teachers and professionals) will select the winning teams.

The objectives of the innovative teaching practice:

- Design buildings with more greenery
- Be part of new trend of built environments
- Design sustainable buildings (cost-benefit analysis)
- Explore methods for sustainable landscaping
- Learn about green building materials and products
- Work in teams, creating new designs, collaborating with students from different disciplines
- This innovative teaching practice is beneficial for students and professionals because they will learn how to design smart and active green walls, facades and rooftops in a sustainable manner.

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills:** direct impact on Critical and Analytical thinking, indirect impact on Planning and organising
- **Soft skills – People related skills**: direct impact on Collaboration and Communication
- **Soft skills – Personal skills**: direct impact on Social responsibility, indirect impact on Work Ethic and Leadership
- **Business skills:** direct impact on Strive for quality and Care for sustainable development



Methods and techniques

- Format - Hackathon
- Techniques completed with individual work: self-assessment quiz
- Techniques completed in teams: team—based learning, discussion, demonstration
- Available resources via e-learning platform: articles, video materials, presentations

Methods for assessment and evaluation of the practice

Methods for assessment

- Team presentations
- Quality of created design and proposed project

Methods for evaluation

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase
- Feedback from involved professionals from industry

INDUSTRIAL MASTER THESIS IN ENGINEERING AND MANAGEMENT

Description of the innovative teaching practice

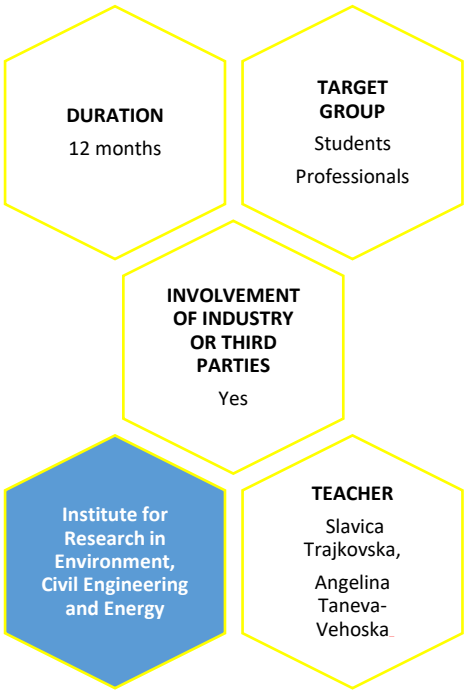
The participants will have opportunity to do research on an interdisciplinary topic, proposed by an industry partner. Each student will have a mentor from university, and co-mentor from industry. At least 3 events will be organized where students will present the progress in their research, communicate the research topic with wider public, promote the research results. This innovative teaching practice is beneficial for students in all engineering fields. These skills are transferable to the work environment and it expected to support them in their career progress.

The objectives of the innovative teaching practice:

- Do research on relevant engineering topic
- Have possibility to collaborate with professionals from industry, and receive direct feedback on the research results
- Explore options for commercialization of the results
- Have higher satisfaction because the knowledge created and research done is meaningful with applicative possibility

Skills to be acquired/ improved:

- **Hard skills – Basic/fundamental skills**: Knowledge in the specialized area, Technical skills
- **Hard skills – Conceptual/thinking skills**: direct impact on Research and managing data and Critical and Analytical thinking
- **Soft skills – People related skills**: direct impact on Collaboration and Communication
- **Soft skills – Personal skills:** direct impact on Professionalism, Flexibility/adaptability, and indirect impact on Work Ethic
- **Business skills:** direct impact on Creativity/innovation, Strive for quality and Dealing with real world problems)



Methods and techniques

- Format > Industrial master thesis
- Techniques completed with individual work: experiments, discovery
- Techniques completed in teams: debate, demonstration, problem solving
- Available resources via e-learning platform: articles, books, presentations, forum, video materials

Methods for assessment and evaluation of the practice

Methods for assessment

- Master thesis
- Presentations

Methods for evaluation

- Evaluation lists and feedback from students
- Testimonials from students during implementation phase
- Feedback from professionals from industry

DEVELOPING SUSTAINABILITY LIFESTYLES

Description of the innovative teaching practice

Based on student investigation, role-models and hands-on projects, inquiry-based learning will be employed as an innovative teaching method that will support the students to acquire and develop new skills oriented toward sustainable lifestyles. The participants will have opportunity to observe their behaviour and challenge themselves for a period of 5 months to experiment with new habits oriented toward more sustainable lifestyle. They will explore individually and in teams many different approaches humans have toward life, environment, resources, and work and explore more sustainable ones. This innovative teaching practice is beneficial for students, and the experience can be inspiration for their work style as well.

The **objectives** of the innovative practice:

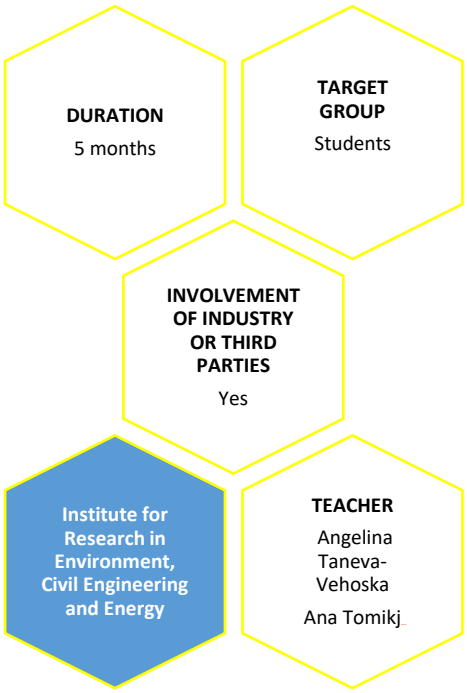
- Challenge unsustainable behaviour and make shift toward more sustainable lifestyle
- Explore the different strategies and approaches in order to use resources in more sustainable manner
- Employ reflexive thinking and action learning techniques
- Supports the participants to uncover their own agency and potential through which they can contribute to a sustainable world
- Development of change agency competences for walking the talk of sustainability, namely personal leadership and self-sustainability competences

Topics that will be covered in this practice:

- Responsible vs. irresponsible use of resources
- Exploring our personal footprint
- Brainstorming ideas to practice sustainable living
- Sustainability lifestyle challenge – personal goal, obstacles and inspiration
- Case studies and real-life examples from Sustainability leaders
- Being sustainable at work

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills**: direct impact on Analytical thinking and Decision making, indirect impact on Planning and organizing
- **Soft skills – Personal skills**: direct impact on Social responsibility and Flexibility/adaptability
- **Business skills:** direct impact on Care for sustainable development and Creativity/innovation



Methods and techniques

- Format > Inquiry-based learning
- Techniques completed with individual work: self-assessment quiz
- Techniques completed in teams: debate, demonstration, problem solving
- Available resources via e-learning platform: quests, articles, video materials, presentations, forum.

Methods for assessment and evaluation of the practice

Methods for assessment

- Pre- and post- self-assessment
- Individual assignments
- Team presentations

Methods for evaluation

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase
- Feedback from involved professionals

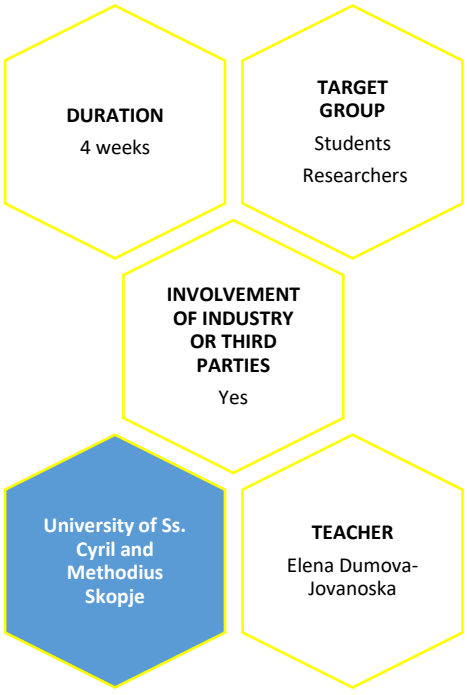
DEMO (SCIENTIFIC) CONFERENCE

Description of the innovative teaching practice

Course participants will be divided in teams. Each team will get a case study that needs to be prepared during the complete course schedule. The case studies are carefully prepared in collaboration with selected companies, and should provide "real life "tone of the assignments. At the finalization of the course a scheduled demo conference will take place, where participants present their work. The rest of the groups have to introduce questions and discussion on the presented topic.

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on Communication and Interpersonal skills (i.e. practice team work)
- **Soft skills – Personal skills**: direct impact on Professionalism (i.e. professional communication, presentation and organization skills)
- **Hard skills – Conceptual/thinking skills**: direct impact on Analytic thinking, (i.e. working on a specific case study)



Methods and techniques

- Format > Case study team work
- Techniques completed with individual work: self-assessment quiz
- Techniques completed in teams: debate, demonstration, problem solving
- Available resources via e-learning platform: articles, presentations, forum, video materials

Methods for assessment and evaluation of the practice

Methods for assessment

- 3 levels of grading:
- Points achieved from evaluation received from course teacher on the delivered case study
- Points achieved from evaluation received from course teacher for the conference participation
- Points achieved from evaluation received from company representative on the delivered case study
- Points achieved from evaluation received from company representative for the conference participation
- Points achieved from evaluation received from other groups for the conference participation

Methods for evaluation

- Evaluation lists and feedback from students

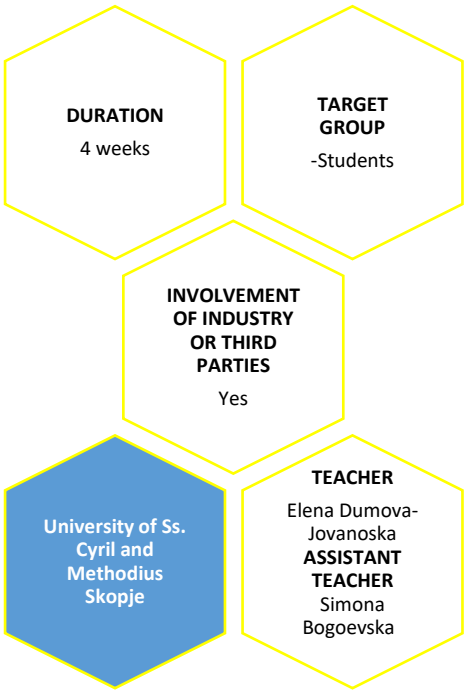
DRONE (REMOTE) PRACTICE

Description of the innovative teaching practice

Interested companies will provide a short description of working areas, working hours and meeting schedules. Each participant in the course will be offered to select from the available list of companies. The selected company will provide a “real-world” task for the participants and include the participants via online platforms in group or one-on-one meetings and discussions. Specific dates will be marked as finalization of the task (as a deadline). Participants will be evaluated by an appointed team from the company for several criteria (i.e. punctuality, motivation, organization, communication etc.). Participants will be evaluated by the course teacher for several criteria (i.e. testing results, case study quality delivered etc.).

Skills to be acquired/ improved:

- **Soft skills - People related skills**: direct impact on Communication and Interpersonal skills (e.g. meet and discuss with management and diverse employees in companies), Personal skills – direct impact on Professionalism and Flexibility/adaptability as well as time optimization
- **Hard skills - Conceptual/thinking skills**: direct impact on Analytic thinking indirect impact on Decision making (e.g. gaining experience in industry and working on actual problem with a team of employees).



Methods and techniques

- Format > "Real world" remote learning
- Techniques completed with individual work: problem solving
- Techniques completed in teams: debate, demonstration
- Available resources via e-learning platform: articles, presentations, forum, video materials

Methods for assessment and evaluation of the practice

Methods for assessment

- Points achieved from evaluation received from an appointed team from the selected company
- Points achieved from evaluation received from course teacher

Methods for evaluation

- Evaluation lists and feedback from students

REAL –TIME REMOTE LABORATORY

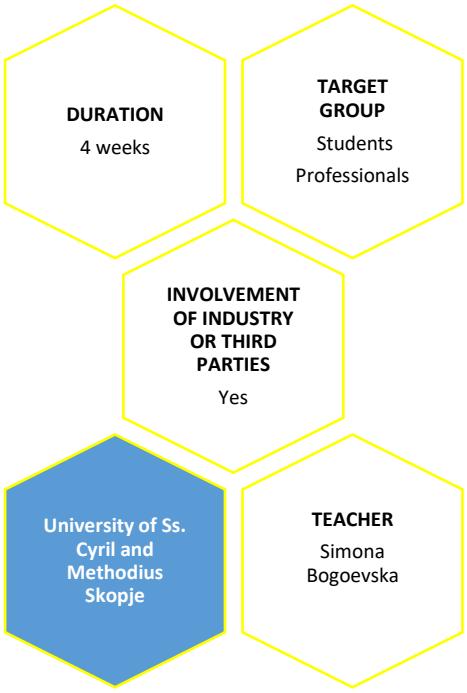
Description of the innovative teaching practice

Each participant in the course will select an available lab experiment from a provided list of web platforms. The list of offered remote laboratories is predefined with involved companies. A specific case study will be appointed, and it will include conducting laboratory experiment. Depending on the covered curriculum, the laboratory web platform can be organised either as:

- Real-time autonomous laboratory
- Real-time remote (one-on-one) communication with lab staff
- Real-time simulation-based “experiments” for software developers

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on Communication and Interpersonal skills (e.g. via discussions and planning lab work with appointed company staff)
- **Hard skills – Conceptual/thinking skills**: direct impact on Analytic thinking (e.g. enhance learning by evaluating experimental data, gained with involvement in all stages of planning and obtaining) indirect impact on Presentation skills (e.g. presenting full case study at the finalization of the course)
- **Business skills**: direct impact on Creativity/innovation (e.g. creating appropriate lab program) indirect impact on developing sense for managing and team work (e.g. apply management for lab staff coordination and team work)



Methods and techniques

- Format > Case study and remote involvement
- Techniques completed with individual work: problem solving and planning strategies
- Techniques completed in teams: debate and demonstration with company support system,
- Available resources via e-learning platform: articles, presentations, forum

Methods for assessment and evaluation of the practice

Methods for assessment

Final presentation of the case study with:

1. evaluation received from an appointed company representative
2. evaluation received from the course teacher

Methods for evaluation

Evaluation lists and feedback from students

ROLE PLAY BASED MODEL

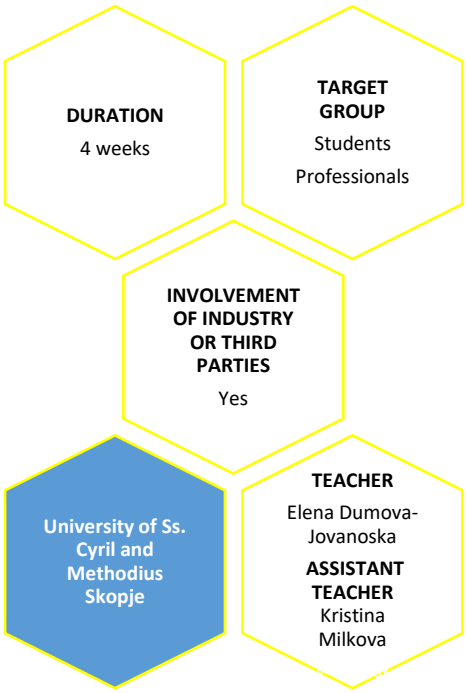
Description of the innovative teaching practice

Each participant in the course will get a randomly selected "anonymous teacher "from the rest of the course participants. Specific dates (depending on the material) will be appointed as testing days and each participant will have an assignment to create a test , define the grading points and afterwards grade the test of his appointed student. Specific dates will be marked as open discussion forums in which all the participants and the actual course teacher, as well as company representative, debate the results and questions. Participants will get points for creating the tests and at the same time for giving answers to a certain test they receive.

All participants will fill a questionnaire for the rest of the group on how each performed during discussion platforms. Each participant in the course will get a randomly selected "anonymous manager "from the rest of the course participants, who will have to appoint a case study previously prepared with a selected company. Specific dates will be marked as open discussion forums in which all the participants, the actual course teacher, as well as company representative debate the case studies. All participants will fill a questionnaire for the rest of the group on how each performed during discussion platforms.

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on Communication and Interpersonal skills (i.e. via open discussion forums where tests and results are debated)
- **Hard skills – Conceptual/thinking skills**: direct impact on Analytic thinking, indirect impact on Decision making (i.e. enhance learning by evaluating colleagues work and understanding quality criteria; estimating points on quiz responses)
- **Business skills:** direct impact on Creativity/innovation (i.e. creating course quizzes and grading system) indirect impact on developing sense for managing (i.e. apply professional objectivity, recognition of quality levels in knowledge, practice responsibility)



Methods and techniques

- **Format >** Role play-based learning
- **Techniques completed with individual work**: problem solving, creation of quizzes and individual grading systems
- **Techniques completed in teams**: debate, demonstration
- **Available resources via e-learning** platform: articles, presentations, forum, trial quizzes

Methods for assessment and evaluation of the practice

Methods for assessment

Points achieved in 3 parts:

- evaluation received from the appointed student for the created quiz and grading system
- evaluation of the quiz he/she took from another “teacher”
- evaluation of participation in discussion forums received from the rest of the group

Methods for evaluation

Evaluation lists and feedback from students

TEACHING COMPUTATIONAL TOOLS BY MULTIMEDIA

Description of the innovative teaching practice

- Contemporary trend in educational technology
- Google search for:
- teaching + multimedia returns about 248,000,000 results
- “teaching +computational tools + multimedia” returns about 12,600,000 results
- Computation tool: computer program or utility that helps users: represent data, perform analysis, visualize data, process databases and etc.
- Multimedia: content that uses a combination of different content forms such as text, audio, images, animations, video and interactive content.
- Innovative practice oriented to structural engineering computational tools
- Communicating with Generation Z (born between 1995-2015) - Utilizing modern information technologies for teaching and learning

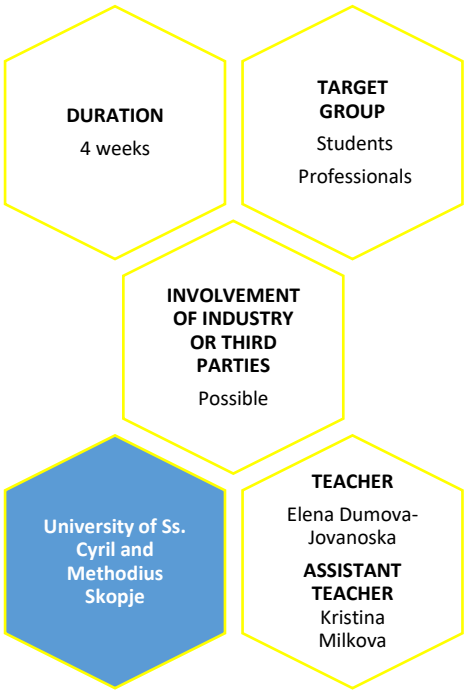
Skills to be acquired/ improved:

Hard skills:

- Computer literacy,
- Structural Engineering analysis programs,
- Multimedia programs,
- Exercises such as assignments to reinforce skills
- Structural Analysis and Finite Element method

Soft skills:

- Critical thinking
- Communication skills
- Exchange of ideas and opinions among students–students and teacher–students; discussions
- Individual learning through practice and feedback (also hard skill)
- Problem solving through trial and error



Methods and techniques

Methods:

- Clarifying and illustrating complex subjects
- Adapting to individual learning styles
- Improving retention and aiding recall
- Reaching nonverbal learners

Techniques:

- Individual work: problem-solving, experiments, trial and error
- Group work: discussions, brainstorming, presentations, demonstrations

Methods for assessment and evaluation of the practice

Methods for assessment:

- Problem solving assignments
- 3-2-1 reflective activity (3 ideas or issues that were learnt, 2 example or uses for how the ideas could be implemented, 1 unresolved area question)

Methods for evaluation:

- Attendance and Completion (Participation)
- Student feedback forms (Data Collection)
- Testimonials (Subjective-Qualitative)

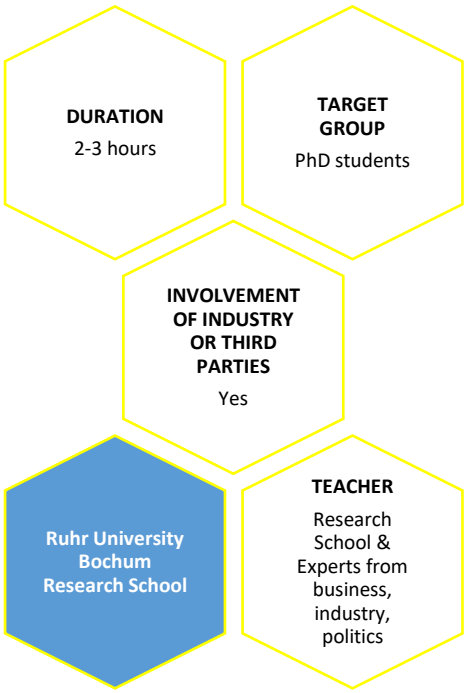
EXCHANGE OF KNOWLEDGE AND EXPERIENCE CAREER OPPORTUNITIES OUTSIDE ACADEMIA FOR PHD HOLDERS

Description of the innovative teaching practice

This innovative teaching practice provides exchange with representatives from industry, economy, politics, NGOs and society provides early career researchers with first-hand information on career possibilities in these sectors. This event promotes the dialogue with a wide range of representatives widening the participant's horizon beyond an academic university career. The focus lies on the individual experiences of invited experts, exemplifying career paths and perspectives beyond academia. Themes addressed include the transition from university to industry, typical career steps in the business world, and career perspectives in selected fields or companies. Moreover, the dialogue serves to identify that early career researchers gain real employability skills during their doctorate. The exchange should stimulate a discussion about the mutual expectations of potential employees and employers.

Skills to be acquired/ improved:

- Early understanding of employability skills of PhD
- Presentation of career possibilities in industry and the public sector
- Providing first-hand information on career opportunities & requirements
- Discussion of mutual expectations for making a career outside academia
- Leading experts share their insider perspectives on activities, strategies and the decision-making processes of job opportunities in industry & public sector
- Visiting companies



Methods and techniques

- Short keynotes / statements of experts
- Moderated panel discussion
- Personal interaction

Methods for assessment and evaluation of the practice

The best evaluation method is to use a combination of summative and formative evaluation. On the one hand, such an approach makes it possible to check whether the expectations and goals set were achieved within the intended time frame with the resources available. On the other hand, this allows recommendations to be made after several events to optimize the exchange and to develop it further accordingly. The combination of qualitative and quantitative data collection methods and the perspectives of various stakeholders should be done, EvaSys is a good choice for collecting data, it's a special evaluation program with an integrated analysis tool. The questionnaire can be filled in an online or paper pencil format.

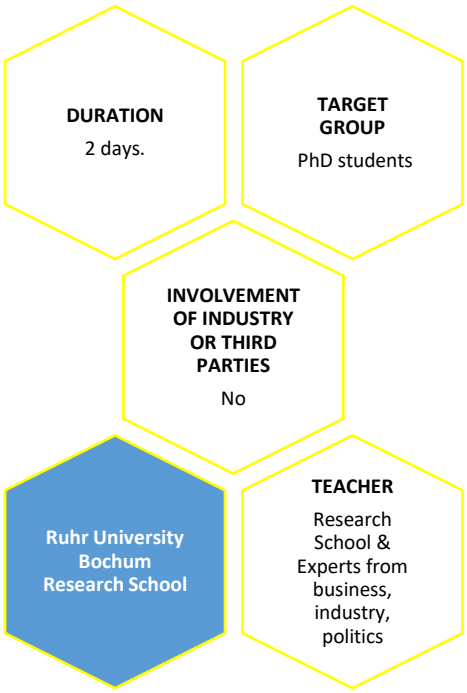
COMMUNICATION SKILLS: ADVANCING COMMUNICATION SKILLS TO SUCCESSFULLY COOPERATE WITH INDUSTRY PARTNERS

Description of the innovative teaching practice

The innovative teaching practices “Communication skills: Advancing communication skills to successfully cooperate with industry partners” provides reflection of the roles and expert status of researchers cooperating with industry. Additionally it discuss the responsibilities of researchers in industry cooperation (including research integrity and ethics) clarifying concerns, aims and interests to cooperate with industry partners. Learners will learn how to develop a communication strategy to ensure a mutual understanding about the project's progress and results discussing successfully the use and dissemination of outcomes and products.

Skills to be acquired/ improved:

- Skills to communicate research projects outside academia
- Professional communication skills of researchers cooperating with industry partners
- Personal communication skills of researchers for diverse settings
- Professional negotiation skills



Methods and techniques

- It will cover topics from profiling and communicating individual research projects for industry cooperation to negotiating interests, aims and conditions to successfully work together with partners from outside academia.
- The workshop will put a special focus on developing professional communication skills for the acquisition of industry projects, for joint meetings, decision-making processes or for negotiating about the use and dissemination of results between researchers and industry partners.
- The workshop will combine expert input with interactive group work and real case scenarios to ensure professional knowledge and a first practice transfer

Methods for assessment and evaluation of the practice

The workshop will be evaluated by the participants by an evaluation form rating the relevance of the workshop's topic and contents as well as the professional performance of the trainer and the benefit for the participants. The trainer will be interviewed to bring in the professional perspective of the expert.

LEADERSHIP SKILLS

Description of the innovative teaching practice

Leadership models - about styles, tasks and responsibilities

- group development
- situational leadership

Delegation, participation and decision-making

- management by objectives
- stewardship delegation

Diversity – how to handle different personalities

- cultural background and professional self-image as leader

Communication for Leaders - typical situations and tools

- face-to-face conversation
- moderations

Feedback and Coaching

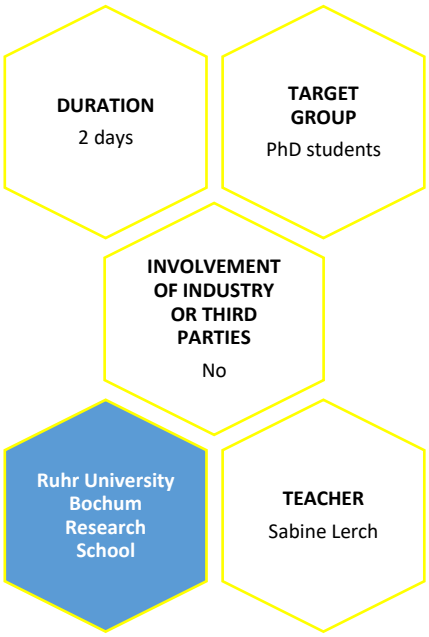
- about orientation and potential

Conflict Resolution - a leader's responsibility

- Harvard Negotiation Principles
- mediation basics

Skills to be acquired/ improved:

- leading teams
- agile working strategies & techniques
- introduction to leadership skills
- creativity and innovation



Methods and techniques

- The workshop aims to provide competencies beyond research qualification. It offers a basic understanding and first knowledge in leadership skills.
- During the workshop the participants will gain insight into different leadership styles and can reflect their own understanding and attitude towards leadership,
- The participants will get to know some instruments of leadership and apply them in realistic case studies and short role plays.
- The workshop will prepare the participants to start approaching this challenging responsibility.

Methods for assessment and evaluation of the practice

- The workshop will be evaluated by the participants by an evaluation form rating the relevance of the workshop's topic and contents as well as the professional performance of the trainer and the benefit for the participants.
- The trainer will be interviewed to bring in the professional perspective of the expert

CAREER PLANNING

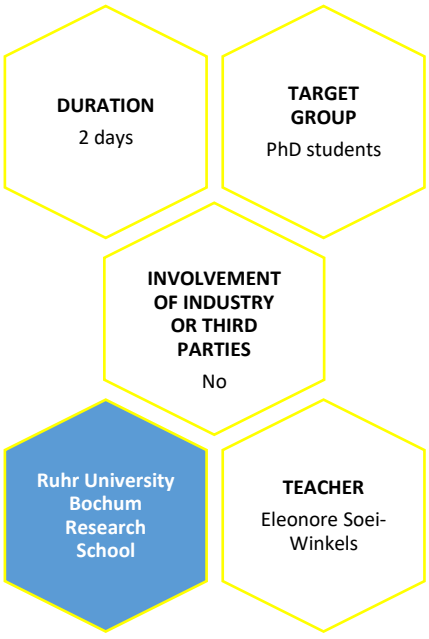
Description of the innovative teaching practice

General landscape: career outside academia - first or second choice
- career compass: pros and cons for a career outside academia
• career paths: opportunities, hurdles and challenges for a career outside academia
• climbing the mountain: competencies are expected from employers
- career horizon: experience, skills and competencies developed by a PhD
Personal career planning*
analysing personal reasons or constraints for a career change
- reflecting personal aims & expectations for a career outside academia
assessing potentials, capabilities & expertise for a non-scientific job
• profiling personal & professional competencies against expected skill sets for a career outside academia
- networking - a career factor?
Take some action:
* creating a non-academic CV
* articulating skills to a non-academic audience

Skills to be acquired/ improved:

• raise awareness for career decisions
• assessing career opportunities outside academia
• gain knowledge & strategies to plan a career outside academia & entrepreneurship in relation to a career in research
• working on personal identity features & skill sets for developing individual career perspectives

• first steps for job application training (industry)



Methods and techniques

The workshop aims to start reflecting and profiling career opportunities outside academia.

- Considering the highly diverse situations of the labour markets of the participating countries the workshop will mainly focus on strategies, competencies and skills described on a metascale by several EU projects.
- The workshop will put a special focus on assessing career opportunities in general, evaluation personal aims & challenges and working our first competence profiles for a career outside academia.
- The workshop will combine expert input with interactive group work and hands-on training to ensure professional knowledge and a first practice transfer

Methods for assessment and evaluation of the practice

- The workshop will be evaluated by the participants by an evaluation form rating the relevance of the workshop's topic and contents as well as the professional performance of the trainer and the benefit for the participants.
- The trainer will be interviewed to bring in the professional perspective of the expert.

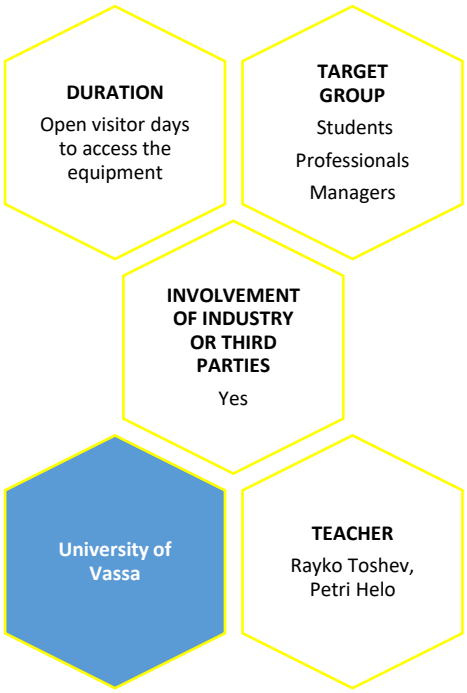
FABLAB

Description of the innovative teaching practice

A fab lab (fabrication laboratory) is a small-scale workshop offering (personal) digital fabrication. A fab lab is typically equipped with an array of flexible computer-controlled tools that cover several different length scales and various materials, with the aim to make "almost anything" The fab lab movement is closely aligned with the DIY movement, open-source hardware, maker culture, and the free and open-source movement, and shares philosophy as well as technology with them.

Skills to be acquired/ improved:

- **Soft skills:** People related skills: networking skills, collaboration/team work
- **Hard skills-Conceptual/thinking skills:** Hans on with 3D printing technology, Use of information technology
- **Business skills-**Creativity/innovation



Methods and techniques

- **Format –** hands-on learning
- **Techniques completed with individual work**: experiments, problem solving, self-learning technology and tools
- **Techniques completed in teams**: problem solving, demonstration, peer support
- **Available resources via e-learning** platform: FabLab networks https://fablabs.io/

Methods for assessment and evaluation of the practice

Methods for assessment: No formal evaluation or credits

Methods for evaluation: Feedback and photos from sessions

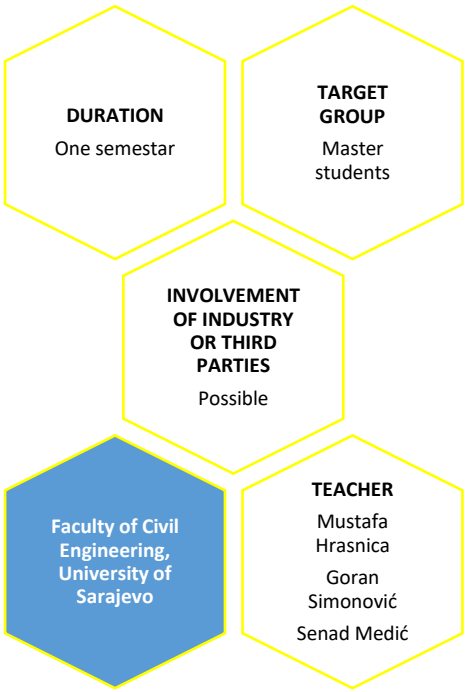
CO-MENTORS FROM BUILDING INDUSTRY

Description of the innovative teaching practice

Master thesis or Diploma thesis comprise independent work of the candidate with regular consultancies and discussions with the mentor/adviser and from time to time with other members of the thesis committee, as a rule university Teachers or academic staff members. However, most of the thesis topics are connected with the engineering praxis. Just the mention that the most valuable research topics are generated directly from building industry. It makes sense to include professional experts from engineering practice directly as a co-mentor, who helps and directs the candidate, using his/her long-time experience acquired in design office or construction company. In some cases, part of the work on the thesis could be organised in cooperative building company. One form of the alliance academia – industry.

Skills to be acquired/ improved:

- **People related skills:** direct impact on communication with colleagues
- **Personal skills:** direct impact on professionalism and flexibility/adaptability
- **Conceptual/thinking skills:** direct impact on analytic thinking, finding practical solutions
- **Business skills:** direct impact on creativity/innovation, practical solutions



Methods and techniques

- Choice of the topic
- Selection of the appropriate expert

- Work on the thesis with regular consultancies with both mentors, from the university and engineering company
- Relation research - practice
- Completing the thesis with both approval
- Thesis defence in front of the large committee, academia+industry

Methods for assessment and evaluation of the practice

Methods for assessment:

- Problem solving assignments
- 3-2-1 reflective activity (3 ideas or issues that were learnt, 2 example or uses for how the ideas could be implemented, 1 unresolved area question)

Methods for evaluation:

- Attendance and Completion (Participation)
- Student feedback forms (Data Collection)
- Testimonials (Subjective-Qualitative)

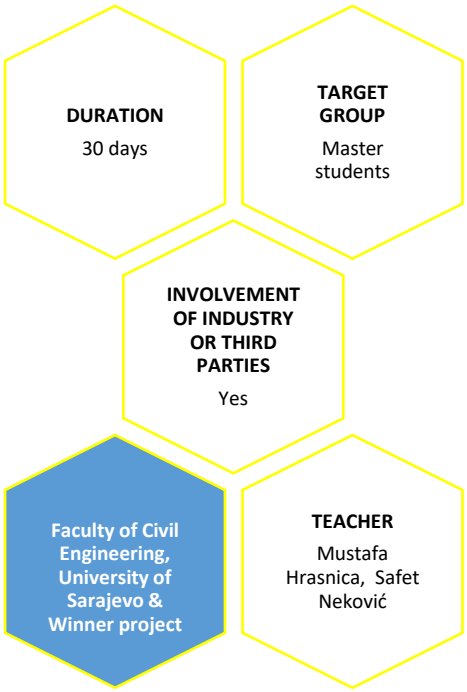
JOB INTERVIEW

Description of the innovative teaching practice

The innovative teaching practice "Job interview" provides learners opportunity for direct communication with potential employers and company managers. In frame of this innovative teaching practice learners will be able to develop their personal portfolio with support from university teacher.

Skills to be acquired/ improved:

- Capability to present himself/herself



Methods and techniques

- Discussions with professionals and teachers
- Preparing of presentations and portfolio

Methods for assessment and evaluation of the practice

- Questionnaires
- Feedback from students

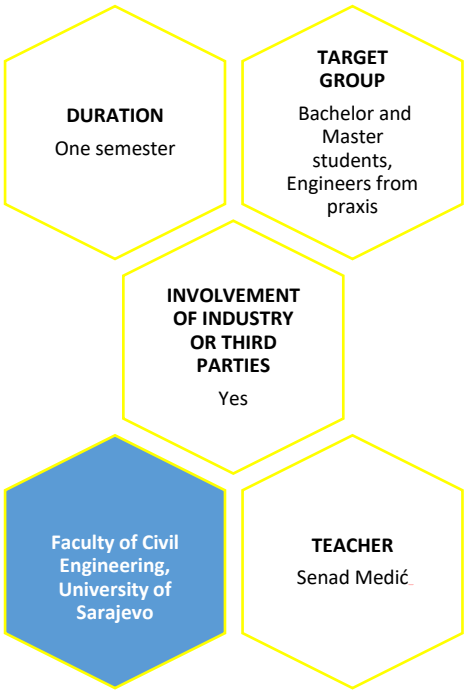
LECTURERS FROM ENGINEERING PRAXIS

Description of the innovative teaching practice

The innovative teaching practice “Lectures from engineering praxis” provides regular lectures from practicing engineers and other professional on different subject: problems in practical structural design of buildings, modern project management, legal and economic issues standard updates. Learners will have the opportunity to learn from first-hand experiences and get practical knowledge about modern project management.

Skills to be acquired/ improved:

- Knowledge about different practical issues, not covered in regular university lectures



Methods and techniques

- Lectures
- Case studies

Methods for assessment and evaluation of the practice

- Questionnaires

LECTURES ON-SITE (FIELD TRIPS)

Description of the innovative teaching practice

The innovative teaching practice "Lectures on-site (field trips) will allow learners to visit to building sites and introduce them to construction works and procedures in real civil engineering praxis.

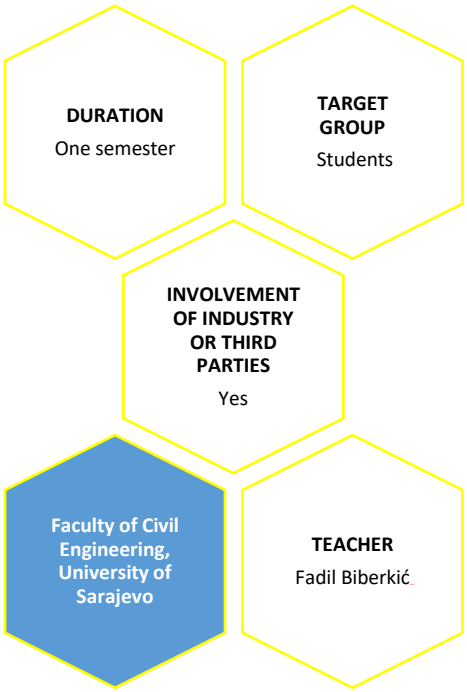
Skills to be acquired/ improved:

Hard skills:

- Computer literacy,
- Structural Engineering analysis programs,
- Multimedia programs,
- Exercises such as assignments to reinforce skills
- Structural Analysis and Finite Element method

Soft skills:

- Critical thinking
- Communication skills
- Exchange of ideas and opinions among students–students and teacher–students; discussions
- Individual learning through practice and feedback (also hard skill)
- Problem solving through trial and error



Methods and techniques

Methods:

- Regular presence on the construction site, e.g. once per week
- Completing construction log
- Direct discussions with engineers and foremen on building-site

Methods for assessment and evaluation of the practice

- Reports
- Presentations at the end of praxis
- Feedback from participants

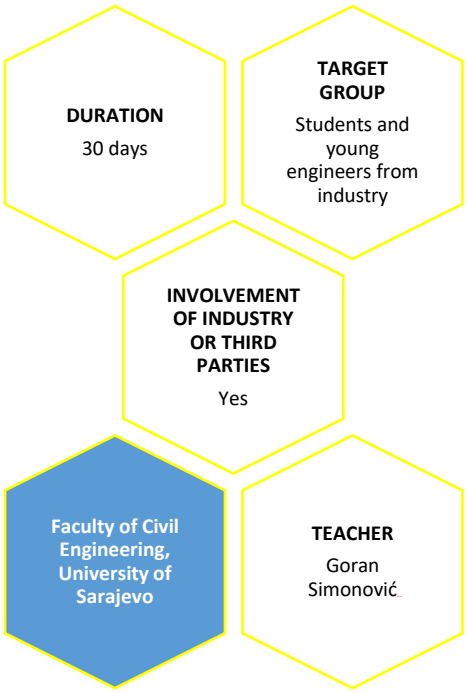
LIVE STREAMING OF DATA FROM SENSORS

Description of the innovative teaching practice

The innovative teaching practice “Live streaming of data from sensors” includes students in work with new equipment acquired through Erasmus+ program. Students will have the opportunity to conduct monitoring of structural performance in real time.

Skills to be acquired/ improved:

- Capability to work with modern measuring equipment
- Critical assessment of the measured data



Methods and techniques

- Hands-on experience with modern measuring devices at the Research and Development Centre at the Faculty of Civil Engineering in Sarajevo
- Implementation of measuring devices on real structure

Methods for assessment and evaluation of the practice

- Reports
- Questionnaire

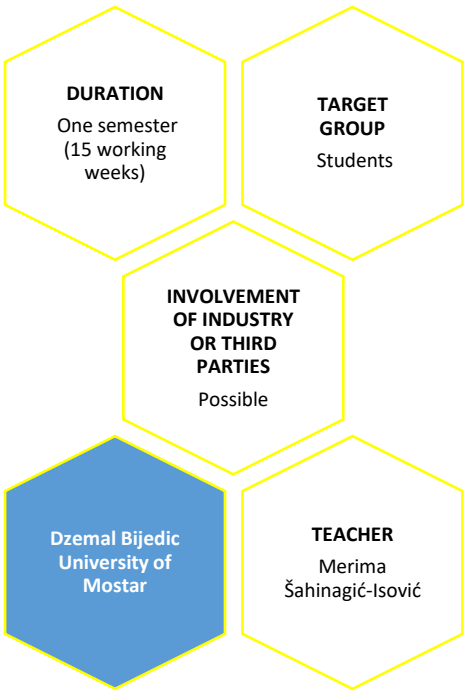
FLIPPED CLASSROOM (REFLECTIVE TEACHING AND LEARNING THROUGH ARGUMENTATION)

Description of the innovative teaching practice

During a course, students will have opportunity to develop new hard and soft skills by participation in the flipped classroom. The methodology is based on engaging the participants in active learning, utilizing several techniques and skills. The participants will work on accomplishing specific goal that will be set by the Teacher at the beginning of the practice. With this learning process, Teacher will determine what they need to teach and what materials students should handle on their own. Class time will be maximized in order to adopt learner-centred an activity-oriented class.

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills**: planning and organizing, ability and desire to learn continuously
- **Soft skills – People related skills**: collaboration/team work and communication
- **Soft skills – Personal skills**: work ethic
- **Business skills:** dealing with real world problems



Methods and techniques

Methods:

- **Format –** Flipped classroom
- **Techniques completed with individual work**: discovery, problem solving, self-learning.
- **Techniques completed in teams**: problem solving – problem-based learning, debate, presentation.
- **Available resources via e-learning** platform: articles, presentations.

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment

Methods for evaluation:

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase

DESIGN THINKING – CASE STUDY (IMPROVE FIELD EDUCATION AND LEARNING FROM PRACTICE)

Description of the innovative teaching practice

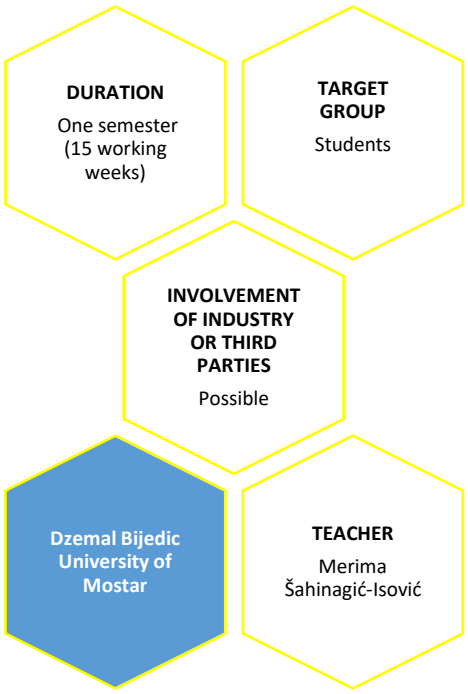
During a course, students will have opportunity to develop new hard and soft skills through design thinking (case study) methodology. The methodology is based on engaging the participants in active learning, utilizing several techniques and skills. The participants will work on accomplishing specific goal that will be set by the professor at the beginning of the practice. They will learn how to work in real multidisciplinary and interdisciplinary environment, how to combine their so far gained knowledge by trying to find appropriate solutions for given problem. In addition, strategy will include site visit and work on real problem within the community.

This innovative teaching practice will develop non-linear mind process in order to understand requests from other professions, final users as well as constrains regarding possible solutions, redefine problems and create innovative solutions, be introduced and work on real problem in the civil engineering sector and work on site in groups.

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills**: planning and organizing, research and managing data
- **Soft skills – People related skills**: collaboration/team work and interpersonal skills
- **Soft skills – Personal skill**s: flexibility /adaptability

- **Business skills**: dealing with real world problems and creativity/innovation



Methods and techniques

- **Format –** project based learning
- **Techniques completed with individual work**: discovery, problem solving, learning, rationality to meet needs of others (users, protected buildings, etc)
- **Techniques completed in teams**: problem solving – problem based learning, debate, presentation, work on site, creativity,
- **Available resources via e-learning** platform: articles, presentations.

Methods for assessment and evaluate on of the practice

Methods for assessment:

- Pre- and post- self-assessment

Methods for evaluation:

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase

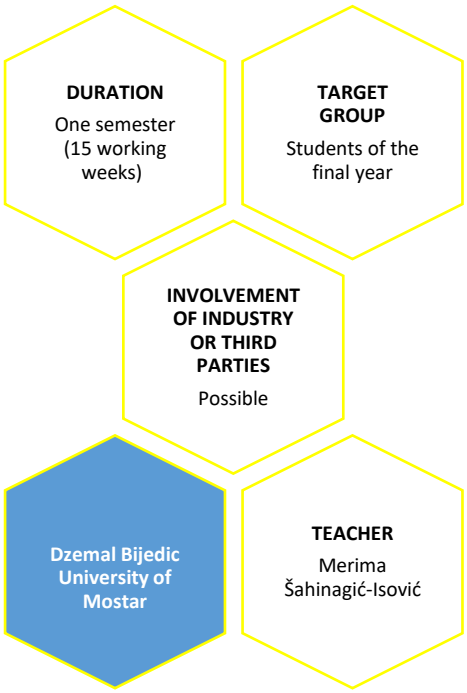
INDUSTRIAL MASTER THESES

Description of the innovative teaching practice

- Defining real problems from the environment on which students could investigate and do the research
- Problems will be defined in collaboration with industry or community /civil / city organizations (schools, sport associations, etc)
- Common issues when defining problems for research are how to provide more user-friendly, environmentally friendly and mentally stimulating space for final users
- Students will get intro information by final user of the chosen space/building
- Students will be mentored by Teacher from the Faculty, but will have guidelines and consultations by representatives of other professions (mainly architects, urban planners, communal engineers, etc) as well as discussions with final users
- Student will have to solve not just construction or material problem faced in their research, but also to offer possible solution for identified social / environmental problem
- Final presentation will done in front of the final users as well in order to get their feed back
- Students will have possibility for development of the "after" work – to wrap up conclusions of their master theses and write a research project to be applied for financing by relevant institutions, all in order to get involved in the community engagement projects

Skills to be acquired/ improved:

- **Hard skills – Conceptual/thinking skills:** critical thinking, decision making
- **Soft skills – People related skills**: collaboration/team work and communication
- **Soft skills – Personal skills**: flexibility / adaptability, voluntarism, social responsibility
- **Business skills**: creativity / innovation, dealing with real world problem



Methods and techniques

- Format – master theses
- Techniques completed with individual work: discovery, determining social needs, self-learning.
- Techniques completed in teams: problem solving – problem based learning, debate, presentation.
- Available resources via e-learning platform: articles, presentations.

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment

Methods for evaluation:

- Evaluation lists and feedback from students
- Testimonials and photos from students during implementation phase

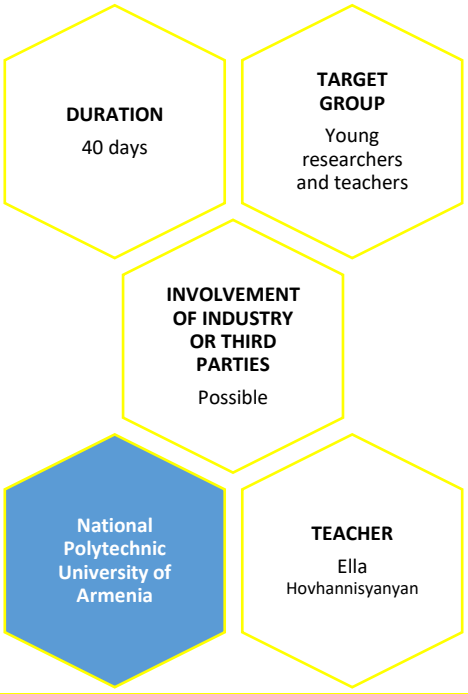
INNOVATIVE RESEARCH TEACHING IN FLIPPED CLASSROOM

Description of the innovative teaching practice

- Innovative practice is focusing on the practical application of knowledge,
- This method will increase the student's engagement, understanding,
- As a result of this practice the students will acquire self-directed, independent learning abilities and for them to apply their knowledge through problem-solving,
- The students will acquire teamwork skills.

Skills to be acquired/improved:

- Engagement and understanding skills,
- Digital literacy skills,
- Potentially building skills in communication and collaboration,
- Independent learning and self-evaluation skills.



Methods and techniques

- Group work on issues based on the flipped material.
- Teacher-directed interaction (teacher prepared questions).
- Individual tasks solving and discussing in groups.
- Plenary discussion after group work.
- Teacher's short presentation clarifying difficult concepts or
- theories based on what students find difficult to understand.
- Student-produced issues based on the flipped material.

Methods for assessment and evaluation of the practice

- Peer review by experts
- Anonymous polling of students
- Feedback from students, peer review

INNOVATIVE TEACHING BASED ON TEAM WORK

Description of the innovative teaching practice

- This is a form of educational and cognitive activity, which involves various small teams working on the tasks of the lecturer
- During the team work, team members interchanging opinions and their skills, which forms students' ability to interact with other team members and listen the opinions of others
- The lecturer monitors the teams work, can take part in discussions, but does not dictate his own opinion, supporting the students to actively search for a solution to the problem
- During forming teams, it is necessary consider the level of academic performance of students and their interpersonal relationship

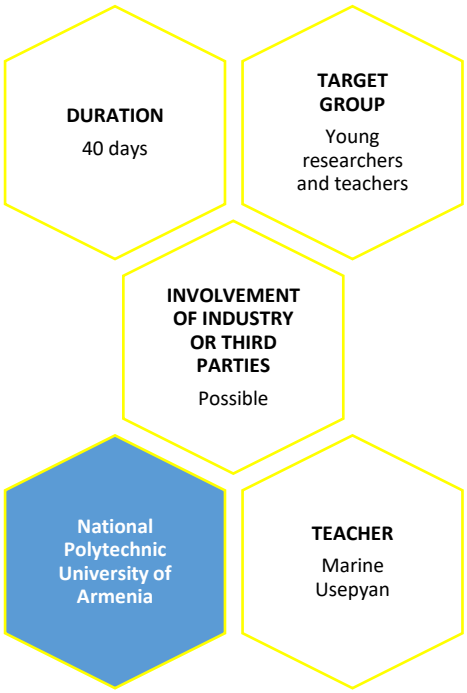
Skills to be acquired/ improved:

The main skills for students are:

- Coordinated student interaction,
- Mutual responsibility,
- Cooperation to each other.

The main skills for lecturer are:

- The work coordination as with the whole group of students, and with each small team



Methods and techniques

- Explanation of the purpose by the lecturer
- Split students into the small teams
- Tasks distribution between teams
- Roles distribution between the team members
- Teamwork monitoring
- Presentation of conclusions by the lecturer after the reports of the teams

Methods for assessment and evaluation of the practice

- Peer review by experts
- Anonymous polling of students

MODULAR APPROACH TO RESEARCH TEACHING

Description of the innovative teaching practice

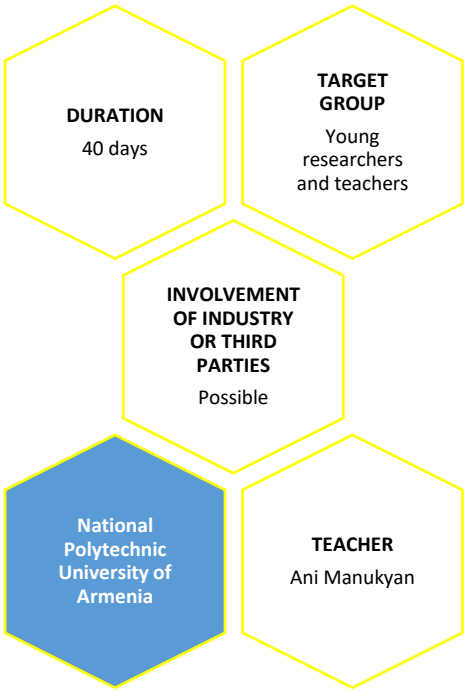
During this innovative teaching practice, the participant will have the opportunity to master the knowledge with separate modules, independent parts of the course, integrated with other parts. Also use interconnected courses with blocks that can be explored independently of another block.

Skills to be acquired/ improved:

The final goal is to empower:

- Orientation to the activity

- The constant response of the lecturer and the students
- The active role of the student
- The new role of the teacher.



Methods and techniques

- Part of the orientation (goals, resources)
- Part of content
- Part of control (how to check the obtained results)
- Part of reflective (self-assessment of the results of work with educational material)

Methods for assessment and evaluation of the practice

- Peer review by experts
- Anonymous polling of students

SITUATION-BASED APPROACH TO RESEARCH TEACHING

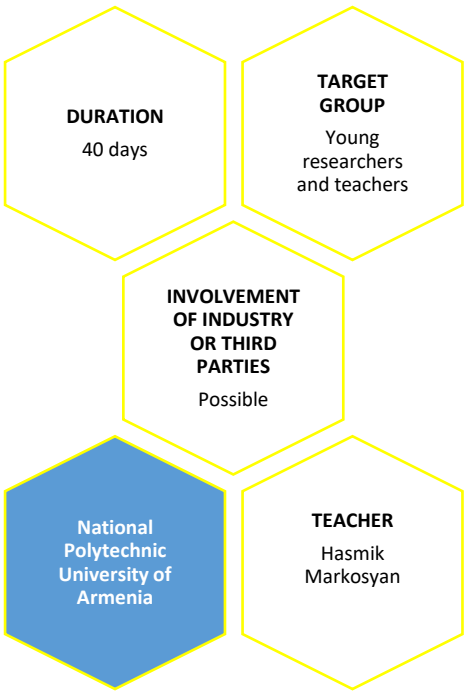
Description of the innovative teaching practice

The idea of situation-based teaching is as follows: the real work situation must be transported into the classroom. It promotes cognitive apprenticeship based on specific situations. The aim is to help the students analyse and find out relevant solutions in various problematic situations.

Case studies are in-depth investigations of a person or a specific situation. It is an effective method for cognitive activities and it promotes the development of analytical skills, reasoning, thinking perceiving, decision making, listening, observing.

Skills to be acquired/ improved:

- Analyse real problems and find relevant solutions
- Develop critical thinking
- Look for different solutions and choose the best one
- Make questions about the situation
- Gather more information about the problem and agree or disagree with offered solutions
- Analyse the given datum and solutions



Methods and techniques

- Creating a new case according to the requirements
- Presenting the case to students and researchers
- The lecturer leads the discussion of the problem presented in the case
-

Methods for assessment and evaluation of the practice

- Peer review by experts
- Anonymous polling of students

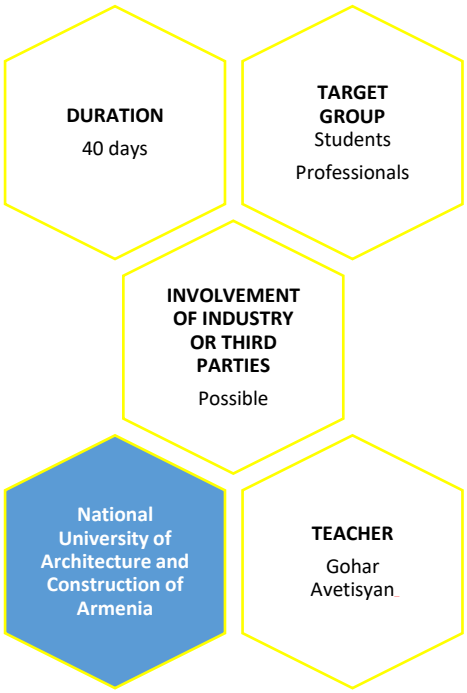
COMPUTATIONAL THINKING

Description of the innovative teaching practice

- During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by thinking and problem solving.
- With this learning process the participants will have opportunity to break large problems down into smaller ones (decomposition), recognize how these relate to problems that have been solved in the past (pattern recognition).

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on Problem Solving Skills (through trial and error)
- **Soft skills – Personal skills:** direct impact on Professionalism (Professional Communication, Organizational skills)
- **Hard skills – Conceptual/thinking skills**: direct impact on Analytic thinking



Methods and techniques

- **Format –** Computational thinking
- **Techniques completed with individual work**: mental models, problem solving, task-solving.
- **Techniques completed in teams**: problem solving, debate, demonstration.
- **Available resources via e-learning platform**: task-solved samples, articles, video materials, presentations.

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment
- Points achieved after problem solving

Methods for evaluation:

- Evaluation lists and feedback from students)

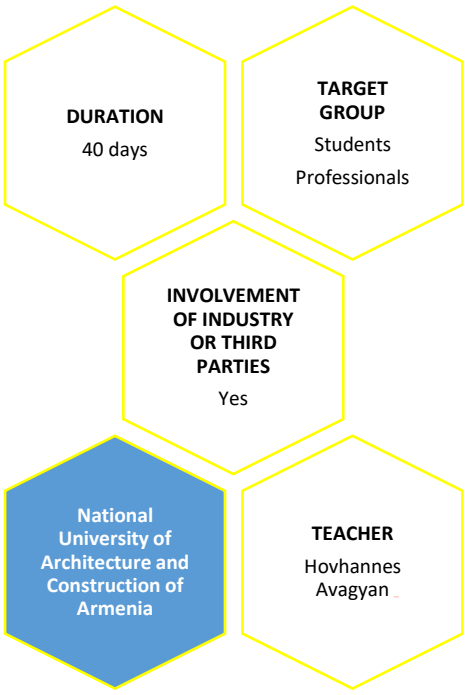
LEARNING BY DOING SCIENCE

Description of the innovative teaching practice

- During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by developing conceptual understanding.
- With this learning process the participants will have opportunity to be engaged with authentic scientific tools and practices such as controlling remote laboratory experiments, can build science inquiry skills, improve conceptual understanding, and increase motivation.

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on science inquiry skills
- **Soft skills – Personal skills:** direct impact on Professionalism by controlling remote laboratory experiments
- **Hard skills – Conceptual/thinking skills**: direct impact on conceptual understanding



Methods and techniques

- Format – Learning by Doing Science
- Techniques completed with individual work: mental models, problem solving, improving conceptual understanding.
- Techniques completed in teams: problem solving, doing experiments.
- Available resources via e-learning platform: articles, remote-experiment video materials, presentations

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment
- Experiments results achieved after doing them

Methods for evaluation:

- Evaluation lists and feedback from students

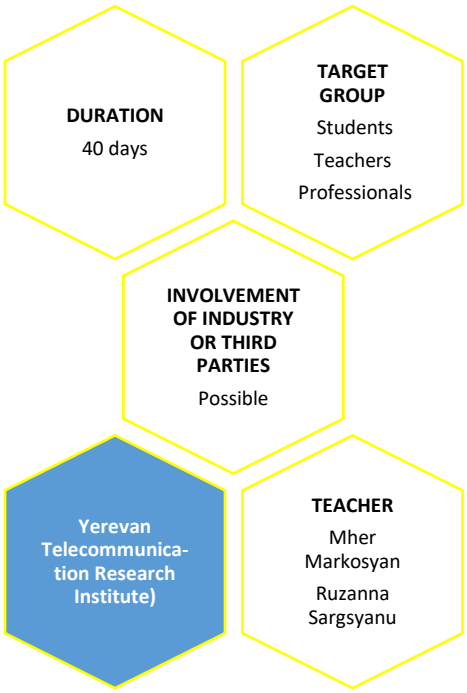
ADAPTIVE TEACHING

Description of the innovative teaching practice

- During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by developing individual task solving.
- All learners are different. However, most educational presentations and materials are the same for all. This creates a learning problem, by putting a burden on the learner to figure out how to engage with the content. It means that some learners will be bored, others will be lost, and very few are likely to discover paths through the content that result in optimal learning.
- Adaptive teaching offers a solution to this problem. It uses data about a learner's previous and current learning to create a personalized path through educational content.

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on individual task-solving skills
- **Soft skills – Personal skills**: direct impact on Professionalism by doing tasks individually
- **Hard skills – Conceptual/thinking skills**: direct impact on individual thinking



Methods and techniques

- **Format** – Adaptive Teaching
- **Techniques completed with individual work**: mental models, problem solving, improving individual conceptual understanding
- **Techniques completed in teams**: individual problem solving to achieve team's goal
- **Available resources via e-learning platform**: articles, video materials, presentations.

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment
- Task-solved results achieved after doing them individually

Methods for evaluation:

- Evaluation lists and feedback from students

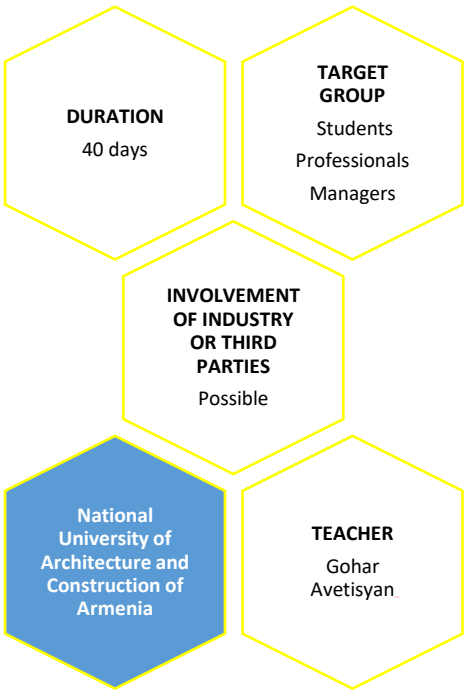
CONTEXT-BASED LEARNING

Description of the innovative teaching practice

- During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by learning from experience and interacting with the surrounding.
- Context-based learning enables us to learn from experience. We have opportunities to create context, by interacting with our surroundings, holding conversations, making notes, and modifying nearby objects.
- We can also come to understand context by exploring the world around us, supported by guides and measuring instruments. It follows that to design effective sites for learning, at universities, construction fields and websites, requires a deep understanding of how context shapes and is shaped by the process of learning.

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on individual skills by learning from experience
- **Soft skills – Personal skills:** direct impact on Professionalism by interacting with the surroundings and changing nearby objects
- **Hard skills – Conceptual/thinking skills**: direct impact on experience-based learning skills



Methods and techniques

- Format – Context-based Learning
- Techniques completed with individual work: problem solving, improving experience-based learning skills
- Techniques completed in teams: interacting with the surroundings and changing nearby objects within a team
- Available resources via e-learning platform: articles, video materials, presentations

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment
- Task-solved results achieved after doing them

Methods for evaluation:

- Evaluation lists and feedback from students

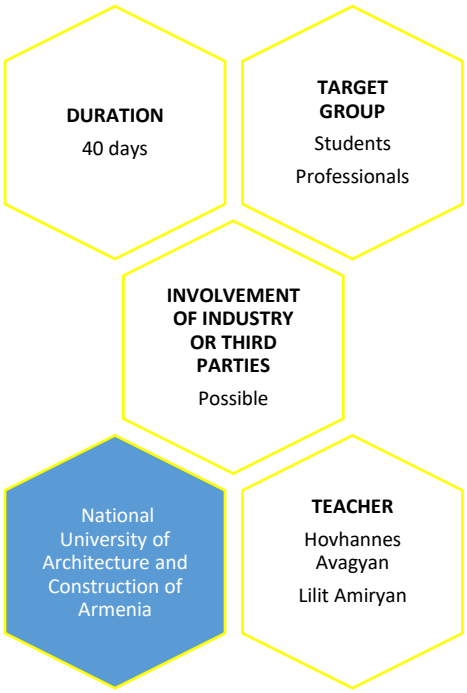
CROSSOVER (INTER-DISCIPLINARY) LEARNING

Description of the innovative teaching practice

- During a period of 40 days the participants will have opportunity to develop new skills and challenge their behaviour by learning from experience and interacting with the surrounding.
- An effective method is for a teacher to propose and discuss a question in the classroom, then for learners to explore that question on a construction, visit or field trip, collecting photos or notes as evidence, using some softs then share their findings back in the class to produce individual or group answers.

Skills to be acquired/ improved:

- **Soft skills – People related skills**: direct impact on individual skills by learning things through inter-disciplinary learning practice
- **Soft skills – Personal skills**: direct impact on Professionalism by exploring questions/issues on a construction, visit or field trip, using various softs
- **Hard skills – Conceptual/thinking skills**: direct impact on experience-based learning skills



Methods and techniques

- Format – Crossover (Inter-disciplinary) Learning
- Techniques completed with individual work: problem solving, improving experience-based learning skills
- Techniques completed in teams: interacting within a team implementing various skills and knowledge acquired in various disciplines
- Available resources via e-learning platform: articles, video materials, presentations, visit or trip experience

Methods for assessment and evaluation of the practice

Methods for assessment:

- Pre- and post- self-assessment
- Tests, quizzes

Methods for evaluation:

- Evaluation lists and feedback from students

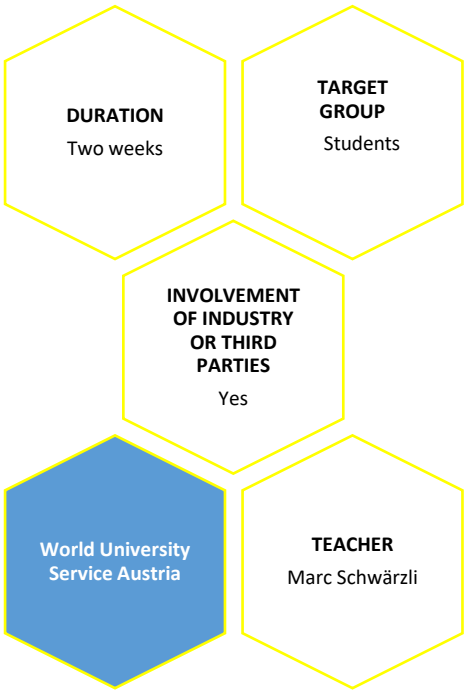
ENTREPRENEURIAL AND CROSS-CULTURAL CASE CHALLENGE COMPETITION

Description of the innovative teaching practice

- What?
    - Cases requiring real solutions, both technical and business competences, which can be best solved in an interdisciplinary team
- Who?
    - Entrepreneurs from partner enterprises provide real live cases for which they need solutions
    - Students compete in the challenge and provide the solutions
    - Teaching staff acts as coaches and moderators
- How?
    - Intensive two weeks for a face-to-face challenge
    - Week 1: Briefing from the case providers, team building and business trainings for the non-business students
    - Week 2: Teamwork with consultancy sessions with the teaching staff. On the last day, a grandiose final event is suggested to be implemented as a motivation booster
    - Each team presents their elevator pitch. A jury consisting of experts from the case-providers and the university selects the best two pitches for every provided case, or if one case if provided, the best solution from each group. The selected teams present their 10-15 minutes presentations within the final round and for each of the cases a winner is selected

Skills to be acquired/ improved:

- Technical and business competences
- Team-work competences
- Problem solving competences



Methods and techniques

- Learning-by-doing
    - The main benefit of this approach is the practical hands-on experience of the students.
- Student centred learning
    - The coaching for each team is designed to provide students with inputs in the relevant areas and to the required extent, based on their needs.
- Blended learning/distance learning (optional)
    - This approach can be conducted as a combination of face-to-face and distance learning, as well as only distance learning. Such approaches may provide bigger flexibility in the selection of companies, crating mixed teams between students from different cities and/or countries, etc.

Methods for assessment and evaluation of the practice

Continuous assessment

- Three compulsory coaching sessions are scheduled in the second week. They are also used for continuous assessment.

Elevator pitch / semi-finals

- The presentation of the elevator pitch is organised based on the number of teams, i.e. in case of smaller number of teams, longer presentations can be allowed, whereas in case of large number of students solutions are presented in short 2-minutes pitches

- The jury selects the two best teams per case, if several cases are provided; if there is only one provided case, semi-final round is divided in several groups and the winner of each group is selected for the final round

Commented / Presented presentation

- The best teams from the first-round present full presentation (10 – 15 min.) – based on which the jury selects the winners (for each case).
- All teams submit their full presentations including additional narrative explanations (as notes), which is available for the case providers and is evaluated by the lecturer(s).
- Students are assessed based on the quality of the conducted analyses and the relevance and applicability of the provided solution, as well as their presentation skills.

ENTREPRENEURIAL TRAINING FOR EMPLOYED PEOPLE

Description of the innovative teaching practice

A blended learning concept combines a custom-tailored MOOC course with concise on-site workshops.

MOOC stands for Massive Open Online Courses. A MOOC is “an online course designed for large number of participants that can be accessed by anyone anywhere, as long as they have an internet connection, is open to everyone without entry qualifications and offers a full/complete course experience online for free” [Brouns et al., 2014].

In addition to traditional course materials, such as filmed lectures, readings, and problem sets, many MOOCs provide interactive courses with user forums or social media discussions to support community interactions among students, Teachers, and teaching assistants (TAs), as well as immediate feedback to quick quizzes and assignments [Wikipedea,2020].

Due to their busy schedule, today’s people often miss out on specific education. In this regard, we can offer them the opportunity to combine busy daily life and top-level entrepreneurship training.

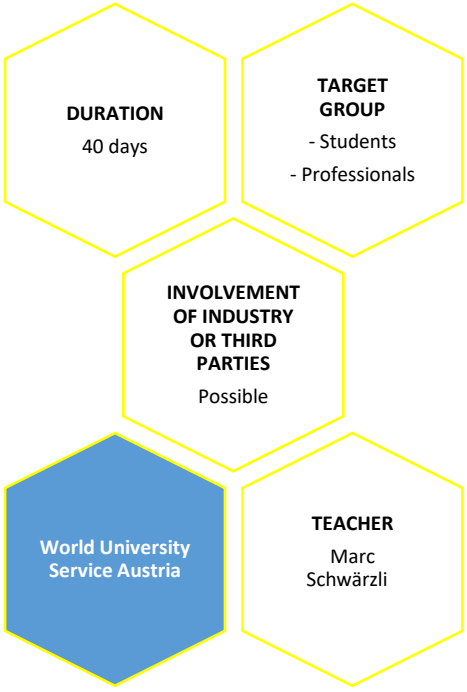
The blended learning concept combines custom-tailored online modules (MOOC) with concise on-site workshops at universities.

- **Example**

  - Entrepreneurship training course
  - Online modules via MOOC (5 to 6 weeks) and on-site courses at universities (2 x 2 days)
  - Language of instruction: English (online), national language (on-site)
  - Entry requirements are optional depending on the specific target group

Skills to be acquired/ improved:

- Face to Face:
    - Learning strategy (learning to learn) and interpersonal skills
    - Finance and decision making
- MOOC based:
    - Starting Line - intercultural exchange and teamwork
    - Communication, self-marketing and leadership
    - Marketing, presentation skills and written communication
    - Understanding business and valuation of business ideas
    - Leading business - entrepreneurship, business plans and innovation management
    - Finish line – reflection and presentation of an elevator pitch
- Face to Face:
    - Understanding of the corporate law, labour law and IPR
    - Project management and drafting of business ideas



Methods and techniques

- Face to Face:
    - Workshop, seminar, training, group work, examples

- MOOC
    - The MOOC supports the learning processes in a diverse, international online group. Experts/facilitators provide different types of materials, questions for discussion and tasks to fulfil with respect to the topics of the week. The moderators/conveners support participants to become active online learner who collaborate with others to complete the tasks and who shares his or her learning experiences on the web.

      Methods for assessment and evaluation of the practice

Methods for assessment and evaluation:

- Face to Face
    - Multiple Choice questions
    - Moodle is for the overall administration of students and the evaluation of the quiz results
- MOOC
    - Minimum number of posts or blogs per week
    - Completion of the weekly assignments
- ECTS
    - An additional test on Moodle is necessary to get the 3 ECTS points

IMPLEMENTATION

Three open calls, organized covering all proposed courses, were specifically scheduled during three time periods. Namely, the three open calls were announced as follows: 1. December 1, 2020 2. March 17, 2021 3. September 8, 2021

In the first open call, 23 courses were offered in all 6 categories. The courses were scheduled within the timeframe of 3 months, namely 15th February till 22nd April 2021. The total number of participants through the online registration form was 485.

21 courses were offered as part of the second call plus 1 innovative practice organized as independent workshop by the Ruhr University Bochum research school. The courses were scheduled within the timeframe of 2 months, namely 5th May till 26th June 2021. The total number of applicants received through the online registration form was 197.

In the third open call, 5 courses were offered in 4 categories plus 1 innovative practice organized as independent workshop by the Ruhr University Bochum research school.

The courses were scheduled within the timeframe of months November 2021 to February 2022. The total number of participants through the online registration form was 79.

Total of 40 courses produced one or two of the proposed attendance plan certificates. To this end, total of 39 courses incorporated variations of knowledge testing (quiz or assignments). The total number of issued certificates is 339, from which 166 for attendance, and 157 for accomplished 2 ECTS. Total number of participants from all offered courses equals 1878.

The distribution of certificates reveals higher interest in the category for engineering software tools. The number of issued certificates is higher although the number of offered courses in this topic is relatively small (total of 6 courses). Total of 18 courses have incorporated and applied some innovative teaching practice.

Successful realisation of the project strengthens the relations between HEIs and the wider economic and social environment. The project objectives were achieved by the increased level of interaction between universities and industry in Armenia and B&H throughout round tables, workshops, national promotional events, study visits, surveys and interviews.

The project positively contributes to the quality of higher education in the fields of Civil Engineering and Information Technologies, and enhance its relevance for the labour market and society in Bosnia and Herzegovina and Armenia. For most universities partnering with industry does not come naturally. This project is oriented toward bridging university and industry and overcoming the challenges.

The foreseen project activities such as research and educational activities between universities and companies enable regional integration and cooperation through joint initiatives, sharing of good practices and cooperation.

All4R&D project is fostering cross-regional cooperation, supporting the modernisation and internationalisation of HE. Addressing the challenges in HE in B&H and Armenia, the project results in enhancing the university-industry collaboration and improves the quality of HE and its relevance for the labour market and society by developing and implementing unique activities in research and education.