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reZEB

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Erasmus+ Programme (ERASMUS) Project: 101128611 — reZEB

Fostering Renewable energy technologies and energy Efficiency knowledge towards near Zero Energy Buildings of engineers and professionals in Western Balkan Countries

DELIVERABLE 3.1: Description of modernised and new modules

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Universidad de Castilla-La Mancha · eCAMPUS UNIVERSITÀ · Neapolis University Pafos · Universiteti Europian i Tiranës · QAA · POLIS · Universum International College · International Business College Mitrovica

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1. Project information, document control sheet and versioning history

Project information

Project Number	101128611	**Acronym**	reZEB
Full Title	Fostering Renewable energy technologies and energy Efficiency knowledge towards near Zero Energy Buildings of engineers and professionals in Western Balkan Countries		
Call	ERASMUS-EDU-2023-CBHE		
Topic	ERASMUS-EDU-2023-CBHE-STRAND-2		
Type of action	ERASMUS Lump Sum Grants		
Coordinator institution	University of Castilla-La Mancha (UCLM), Spain		
Project URL	https://rezebproject-eu.com/		
Project starting & ending date	01 November 2023 – 31 October 2026 (36 months)		

Document control sheet

Deliverable title	D 3.1: Description of modernised and new modules			
Work package (WP) name & WP leader (WPL)	WP3: Development / WPL: University eCampus (UEC) (leader) & International Business College Mitrovica (IBC-M) (co-leader)			
Deliverable lead institution	UEC			
Author(s) (Names and affiliations)	Luca Cioccolanti (UEC)			
Nature & Dissemination level	**Deliverable nature**	R – Report	**Dissemination level**	PU-Public
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Versioning and contribution history

Rev. No.	Issue date	Author/Reviewer (Name and affiliation)	Action description
v0.1	06/10/2024	Luca Cioccolanti (UEC)	First draft
v0.2	15/10/2024	Juan José Hernández & Amparo Pazo (UCLM)	Minor modifications and corrections on the document layout and content.
V0.3	31/10/2024	Project Executive Committee (PEC)	Approval of the draft and submission to EU

2. Deliverable description

This document presents a short description of the procedure implemented for the selection of the modules to be modernised or introduced as new by partner Higher Education Institutions (HEIs) in Western Balkan Countries involved in reZEB project. One of the main goals of the project, indeed, are the modernisation of the curricula in the five HEIs of Partner Countries with up-to-date content on renewable energy technologies (RETs) and energy efficiency (EE) in buildings also based on the feedback received from the labour market. In addition, it includes the details of the syllabi of the selected modules at HEIs of Partner Countries that will be taught in the next two years of the project.

Hence, the document is structured as follows. Section 3 provides an overview of the methodology used to select the modernised and new modules while Section 4 shows the details of these modules

3. Methodology

At the time of the proposal submission, the five Western Balkan HEIs involved in reZEB project had already preliminary identified the modules to be modernised or introduced as new in their curricula in accordance with their needs and based on their regular talks with representative of the labour markets. The identified modernisation was totally worth about 110 ECTS since for each HEI at least 5 modules would be the object of the modernisation of which at least 1 introduced as new.

The survey on the labour market needs carried out during the first months of the project (Deliverable 2.1) has confirmed the interest towards the topics of RETs and EE which special focus on solar energy and energy management [1]. Therefore, the results of the survey have been used by the five HEIs to further elaborate the selection of the modules to be modernised and their related content with the final aim of satisfying the current and future labour market needs in Albania and Kosovo. It is worthy to remark that, together with the latter comment, the selection of the new content has also been based on the academic profile of each HEI (architecture, business, engineering, VET, …).

The selection of the modules was presented during the 2nd internal project meeting in Rome (April 2024) and further discussed through multiple online meetings between EU partners and each Western Balkan HEI of the reZEB project. As a result of these meetings the modernised content and teaching methods were further modified and improved and the final structure of the syllabi was discussed during the 3rd internal project meeting in Mitrovica (September 2024). Afterwards, the final version of the syllabi was discussed with the members of the External Advisory Board (EAB) before their final submission through this deliverable. The EAB general consideration and feedback after the meeting are summarised in a signed letter attached as a separate file.

4. Modernisation of the curricula

4.1 Modules summary

The target for the number of modules to be modernised or introduced as new and that of the modernised ECTS have been met. The total number of modernised or new modules is 26, of which 16 are modernised and 10 new. This modernisation accounts about 110 ECTS. In the following tables the list of the selected modules together with some details is reported for each Western Balkan HEI of the reZEB project. Furthermore, it should be noted that 21 of the 26 modules will start to be taught in the current academic year and the remaining 5 in the academic year 2025-2026.

Table 1. List of selected modules at European University of Tirana (Albania)

Name of the module	Degree Level	Number of ECTS	% of modern.
Building Plants and Hydraulics	BA	5	55
Electrical Plants and Safety	BA	6	55
Electrical systems	BA	6	55
Electrical and Energy Measurements	MA	6	new (100)
Energy Management	MA	6	new (100)

Table 2. List of selected modules at Polis University (Albania)

Name of the module	Degree Level	Number of ECTS	% of modern.
Building materials and constructive techniques	Integrated MA	6	70
Building Retrofit Strategies for Sustainable Urban Regeneration	Integrated MA	6	new (100)
Architectural Technology	Integrated MA	6	65
Environmental Design Studio	Integrated MA	6	60
Technical Physics and Plant Engineering	Integrated MA	6	65

Table 3. List of selected modules at Professional College of Tirana (Albania)

Name of the module	Degree Level	Number of ECTS	% of modern.
HVAC and cooling control systems	VET	6	>50
Engineering materials/Metrology	VET	6	>50
Applied thermo-technics	VET	6	>50
Energy allocation and use	VET	6	>50
Energy auditing	VET	6	new (100)

Table 4. List of selected modules at Universum International College (Kosovo)

Name of the module	Degree Level	Number of ECTS	% of modern.
Understanding Energy Resources and Consumption	BA	6	new (100)
Life Cycle Management	BA	6	new (100)
Sustainable Economic Development	BA	6	60
Energy Management	MA	6	new (100)
Financial Management	MA	6	new (100)

Table 5. List of selected modules at International Business College Mitrovica (Kosovo)

Name of the module	Degree Level	Number of ECTS	% of modern.
Environmental Law and EU policies	BA	5	55
Project Management	BA	5	50
Renewable energy	BA	5	50
Advanced Natural Resources Management	MA	5	50
Energy Management	MA	5	new (100)
Life Cycle Assessment	MA	5	new (100)

4.2 Syllabi

The detailed syllabi for the modernized/new modules are provided in Annexes 1 to 5. A similar general structure has been kept for all the modules although, in agreement with the internal rules of each HEI, slight differences can be observed in the information provided. The general layout of the syllabi is shown in Table 6. Furthermore, the modernized content (topics, seminar, labs…) has been highlighted in yellow together with the equipment purchased with the reZEB budget. Obviously, the new modules do not require such discrimination.

Table 6. Syllabi general structure

Syllabi section	Content
Institution	Name of the institution
Module (tittle)	Name of the module
Full name of the professor	Full name of the professor
Hours	Number of hours distinguishing between: • Lectures • Practical hours with the teacher (labs, seminars, workshops…) • Independent students work
Program	• Study program that the module refers to • Academic year and semester • Number of ECTS • Mandatory or optional • The academic year to start to be taught
Learning outcomes	• Knowledge and Understanding • Capacity to apply Knowledge and Understanding. • Transversal Skills
Content	Description of the subjects to be taught (lectures, labs and other activities)
Methodology	• Learning Evaluation Methods • Learning Evaluation Criteria • Learning Measurement Criteria • Final Mark Allocation Criteria
Bibliography	Suggested bibliography
Educational resources	Equipment, software or any other educational resource to be employed.

4.3 Accreditation documents

Accreditation documents are provided in a separate file as they are considered sensitive information. Since the modernized/new modules do not represent more than a specific % of the total ECTS of the study program (typically 20%), and in accordance with the educational laws of Western Balkans, the Balkan partners institutions only need approval at their institution level.

Abbreviations

Abbreviation	
BA	Bachelor
EAB	External Advisory Board
EE	Energy efficiency
HEIs	Higher Education Institutions
HVAC	Heating, ventilation, and air conditioning
IBC-M	International Business College Mitrovica
KPT	Professional College of Tirana
MA	Master
PEC	Project Executive Committee
RETs	Renewable energy technologies
Rev.	Revision
reZEB	Fostering Renewable energy technologies and energy Efficiency knowledge towards near Zero Energy Buildings of engineers and professionals in Western Balkan Countries
UC	Universum International College
UCLM	University of Castilla-La Mancha
UEC	University eCampus
UET	European University of Tirana
U_POLIS	Polis University
VET	Vocational education and training
WP	Work package
WPL	Work package leader

References

[1] L. Cioccolanti et al., "Analysis of labour market needs for engineers and professionals with enhanced knowledge in renewable energy solutions and energy efficiency in the built environment in some Balkan Countries," Proceedings of the 8th International Conference on Contemporary Problems of Thermal Engineering- CPOTE 2024, 23-26 September 2024, Poland.

Annex 1: European University of Tirana Syllabi (UET)

MODULE: BUILDING PLANTS AND HYDRAULICS

Institution	European University of Tirana
Module (Title)	**BUILDING PLANTS AND HYDRAULICS**
Full Name of the Professor	Prof. Dr. Andonaq Londo, MSc. Hasimin Keçi
Hours:	42 hours in total, 28 hours lectures and 14 hours seminars
Program	Bachelor, Integrated Diploma in Architecture. 5 ECTS. 2024 – 2025, 2nd year; 2nd semester. Mandatory.
Learning outcomes	**Knowledge and Understanding** Throughout the course, students will: - understand the principles of hydraulic systems in buildings and their role in enhancing energy efficiency - understand the principles and components of solar thermal panel systems and their integration with hydraulic systems. **Capacity to apply Knowledge and Understanding** By the end of this course, students will be: - able to analyze the energy performance of various hydraulic systems in buildings and identify opportunities for energy efficiency improvements. - able to design, simulate, and optimize hydraulic distribution networks that minimize energy losses and enhance system performance. - able to critically assess regulatory and technological developments related to energy efficiency in hydraulic systems for buildings **Transversal Skills** - Collaborate with peers and interdisciplinary teams to solve complex hydraulic engineering problems, integrating environmental sustainability considerations and demonstrating project management, communication, and critical thinking skills essential for professional practice.
Content	**Topic I – Physical properties of fluids; Basic hydrostatics equation;** (2 hours lesson; 1 hour seminars) This topic explores the fundamental physical properties of fluids, including density, viscosity, surface tension, and compressibility, which influence fluid behavior in both static and dynamic states. Students will learn to apply the basic hydrostatics equation, which relates pressure, fluid density, gravity, and depth in a fluid at rest.

	Topic II – Basic hydrostatics equation; Differential equations of fluid equilibrium at rest; The shape of the equation under the action of gravitational forces; Equation of equilibrium and equipotential surfaces; Hydrostatic pressure types; pressure ulcers; pressure gauges (2 hours lesson; 1 hour seminar) This topic covers the **basic hydrostatics equation** and extends into the **differential equations of fluid equilibrium at rest**, focusing on fluids under the influence of **gravitational forces**. Students will explore the derivation and application of these equations to understand how pressure varies with depth and position in a static fluid. The concept of **equipotential surfaces** and their relationship to equilibrium will also be examined. **Topic III – Compressive forces on flat and curved surfaces.** (2 hours lesson; 1 hour seminar) This topic focuses on the analysis of **compressive forces** exerted by fluids on **flat** and **curved surfaces** in hydraulic systems and structural applications. Students will learn to calculate the resultant force and pressure distribution acting on surfaces submerged in a fluid, considering the geometry of the surfaces and fluid properties. **Topic IV – Fluid statics in areas of inertial forces.** (2 hours lesson; 1 hour seminar) This topic examines the behavior of fluids at rest within systems subjected to **inertial forces**, such as those caused by acceleration or rotation. Students will explore how inertial forces influence fluid pressure and distribution, modifying the principles of fluid statics. Key concepts include the analysis of fluid behavior in accelerating containers and rotating systems, with applications in fields like aerospace, marine engineering, and mechanical design. Understanding these dynamics is crucial for solving engineering problems related to non-uniform pressure fields and designing stable fluid systems under varying inertial conditions. **Topic V – Fluid Dynamics; Bernoulli equation; flow regimes. Viscous and non-viscous fluids.** (2 hours lesson; 1 hour seminar) This topic introduces the fundamentals of **fluid dynamics**, focusing on the behavior of fluids in motion. Students will explore the **Bernoulli equation**, which relates pressure, velocity, and elevation in steady, incompressible flows, providing insights into energy conservation within fluid systems. The topic also covers different **flow regimes**—laminar and turbulent—and the distinction between **viscous** and **non-viscous fluids**, examining how viscosity affects flow characteristics. Practical applications include analyzing fluid flow in pipelines, pumps, and ventilation systems, with emphasis on optimizing performance and energy efficiency in engineering designs. **Topic VI – Energy Losses; Longitudinal and country losses; Understanding longitudinal losses; loss coefficient; flow regimes; Nikuradze graph. Moodi Diagram.** (2 hours lesson; 1 hour seminar) This topic explores **energy losses** in fluid systems, with a focus on **longitudinal losses** (due to friction along the length of pipes) and **local losses** (caused by fittings, bends, and other obstructions). Students will gain an understanding of how these losses affect fluid flow efficiency and learn to calculate the **loss coefficient**. The relationship between **flow regimes** (laminar and turbulent) and energy losses will be analyzed using tools like the **Nikuradze graph** and the **Moody diagram**, which

	are essential for predicting friction factors and optimizing fluid transport in pipelines and hydraulic systems. **Topic VII - Integration of Solar Thermal Panels in Hydraulic Systems** (2 hours lesson; 1 hour seminar) This topic examines the integration of solar thermal panels into hydraulic systems, focusing on how solar energy can be harnessed to heat fluids for building and industrial applications. Students will explore the design principles of solar thermal systems, including heat transfer mechanisms, system components (collectors, storage tanks, pumps), and the hydraulic integration required for efficient operation. Emphasis will be placed on optimizing energy efficiency, sustainability, and performance in both residential and commercial contexts, highlighting the environmental and economic benefits of renewable energy integration in fluid systems. **Topic VIII - Energy-Efficient Distribution Systems for Heating and Cooling** (2 hours lesson; 1 hour seminar) This topic focuses on the design and optimization of energy-efficient distribution systems for heating and cooling in buildings and industrial environments. Students will learn about modern technologies and methods for reducing energy consumption in hydraulic-based heating and cooling systems, such as radiant heating, chilled water systems, and variable flow systems. The topic emphasizes sustainable design principles, including proper insulation, system balancing, and the use of renewable energy sources, all aimed at minimizing energy losses and maximizing overall efficiency in temperature control. **Topic IX - Advanced Control Strategies for Hydraulic Systems** (2 hours lesson; 1 hour seminar) This topic delves into advanced control strategies for optimizing the performance and efficiency of hydraulic systems. Students will explore various control techniques, such as proportional-integral-derivative (PID) control, model predictive control (MPC), and adaptive control, tailored to manage complex hydraulic processes. The course will cover the implementation of these strategies to enhance system responsiveness, stability, and energy efficiency. Practical applications include improving the precision of hydraulic actuators, managing variable flow rates, and integrating control systems with digital technologies for real-time monitoring and automation. **Topic X - Heat Recovery Systems in Building Hydraulics** (2 hours lesson; 1 hour seminar) This topic explores heat recovery systems within the context of building hydraulics, focusing on technologies designed to capture and reuse waste heat from various building processes. Students will learn about the principles and components of heat recovery systems, including heat exchangers, thermal storage, and integrated controls. The course covers methods for integrating these systems into existing hydraulic networks to enhance energy efficiency and reduce operational costs. Emphasis is placed on practical applications, system design considerations, and the benefits of heat recovery for improving sustainability and reducing environmental impact in building operations. **Topic XI - Regulatory Standards and Energy Efficiency Certifications for Hydraulic Systems** (2 hours lesson; 1 hour seminar)

	This topic covers the regulatory standards and energy efficiency certifications relevant to hydraulic systems. Students will examine key regulations and guidelines governing hydraulic system design, installation, and operation, including international standards and local codes. The course will explore various energy efficiency certifications, such as LEED, BREEAM, and ENERGY STAR, and their implications for hydraulic system performance and sustainability. Emphasis is placed on understanding compliance requirements, implementing best practices for energy efficiency, and achieving certifications to enhance system reliability, performance, and environmental responsibility. **Topic XII - Innovative Insulation Techniques for Hydraulic Piping** (2 hours lesson; 1 hour seminar) This topic explores innovative insulation techniques for hydraulic piping, focusing on methods to enhance thermal efficiency and reduce energy losses in piping systems. Students will study advanced insulation materials and technologies, such as aerogel, vacuum-insulated panels, and advanced composite materials, along with their application in various hydraulic systems. The course covers design considerations, installation practices, and the impact of effective insulation on system performance, energy conservation, and cost savings. Emphasis is placed on practical solutions for optimizing insulation in both new and existing hydraulic infrastructure. **Topic XIII – Hydraulic Balancing and Its Impact on Energy Efficiency** (2 hours lesson; 1 hour seminar) This topic focuses on hydraulic balancing and its crucial role in optimizing energy efficiency within hydraulic systems. Students will learn techniques for achieving proper balance in hydraulic networks, including the use of balancing valves, flow measurement, and system adjustments to ensure uniform distribution of fluids. The course explores the relationship between hydraulic balance and energy consumption, highlighting how effective balancing can reduce energy waste, enhance system performance, and improve overall efficiency. Practical applications include optimizing heating, cooling, and water distribution systems in buildings and industrial facilities. **Topic XIV - Optimization of Hydraulic System Design for Renewable Energy Integration** (2 hours lesson; 1 hour seminar) This topic explores the optimization of hydraulic system design to effectively incorporate renewable energy sources. Students will examine strategies for integrating technologies such as solar thermal systems, geothermal energy, and biomass into hydraulic networks. The course covers design considerations, including system configuration, energy storage solutions, and control mechanisms to maximize the efficiency and reliability of renewable energy integration. Emphasis is placed on achieving optimal performance, reducing reliance on non-renewable energy sources, and enhancing sustainability in hydraulic systems for various applications.
Methodology	**Learning Evaluation Methods**. Active participation in seminar classes Mid-term exam Course assignment Final exam

Learning Evaluation Criteria.
The evaluation aims at verifying the student's knowledge and understanding of the basic functioning.
The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course.
The highest score is achieved by demonstrating in-depth knowledge of the course contents.
Praise is given to students who are particularly brilliant in exposure and/or demonstrate mastery of the matters treated in the course, being able to analyze topics not explicitly.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise

Points	Exam test
91 – 100	Excellent/pass
71 – 90	Good/pass
41 – 70	Normal/pass
0 – 40	Bad/no pass

Final Mark Allocation Criteria.
Active participation in seminar classes (10%)
Mid-term exam (30%)
Course assignment (20%)
Final exam (40%)

Bibliography

Plumbi R., Londo A., Mekanika e fluideve, SHBLU, Tiranë 2019;
Londo A., Konomi I. etj., Mekanika e lëngjeve ushtrime, SHBLU, Tiranë 2019;
Y.Cengel, J Cimbala, Fluid mechanics; fundamentals and applications, Blue Print, London 2018.

Educational resources

Desktop computers. (In all the topics).
Projector (In all the topics).
Multimeter. (In topic X).
Thermal imaging cameras. (In topics X and XIII).

Institution	European University of Tirana
Module (Title)	**ELECTRICAL PLANTS AND SAFETY**
Full Name of the Professor	MSc. Ing. Jani Petro
Hours:	56 hours in total, 28 hours lectures and 28 hours seminars
Program	Bachelor's Degree, Industrial Engineering, Electrical profile. 6 ECTS. 2024 – 2025, 3rd year; 2nd semester. Optional.
Learning outcomes	**Knowledge and Understanding** Throughout the course, students will acquire: - an understanding of the principles of electrical plant design and safety regulations, focusing on energy-efficient practices and standards in building environments. **Capacity to apply Knowledge and Understanding** By the end of this course, students will: - be able to apply techniques and methodologies for designing energy-efficient electrical systems in buildings, ensuring compliance with EU energy efficiency directives and safety standards; - be able to critically assess and evaluate the energy efficiency of existing electrical systems in buildings, proposing improvements and upgrades that enhance performance while maintaining safety. - be able to effectively communicate technical information and recommendations regarding energy-efficient electrical systems and safety measures to diverse stakeholders; - develop the ability to stay informed about advancements in energy-efficient electrical technologies and evolving EU regulations, demonstrating a commitment to continuous professional development in the field; - be able to implement maintenance strategies to ensure the long-term efficiency and reliability of power plant equipment and systems; - be able to analyze case studies and real-world examples to understand the practical application of energy-efficient and safe power plant operation. **Transversal Skills** - Collaborate efficiently with interdisciplinary teams to design and implement electrical systems, demonstrating leadership, coordination, and problem-solving skills in achieving project objectives.
Content	**Topic I – Electric energy, its generation, and transportation.**

(2 hours lesson; 2 hour seminar)
This topic explores the fundamentals of **electric energy**, focusing on its **generation** and **transportation**. Students will learn about various methods of generating electrical energy, including **thermal**, **hydroelectric**, **wind**, and **solar** power. The course covers the principles of energy conversion, efficiency considerations, and environmental impacts. Additionally, students will examine the infrastructure required for **transporting** electrical energy from power plants to end-users, including **transmission lines**, **substations**, and **distribution networks**. Emphasis is placed on understanding the entire energy supply chain, from generation through to delivery, and the challenges and technologies involved in ensuring reliable and efficient electrical power distribution.

Topic II – Electric power generation plants and their key factors
(2 hours lesson; 2 hours seminar)
This topic delves into **electric power generation plants**, focusing on their design, operation, and key influencing factors. Students will explore different types of power plants, including **thermal**, **nuclear**, **hydroelectric**, and **renewable** facilities, and understand their operational principles. The course covers essential factors such as **efficiency**, **capacity**, **fuel sources**, **environmental impact**, and **safety considerations**. Emphasis is placed on evaluating plant performance, managing operational challenges, and optimizing power generation to meet demand while minimizing environmental effects and ensuring reliable energy supply.

Topic III – Renewable Energy Technologies: Study of renewable energy sources such as solar, wind, hydroelectric, and geothermal power generation.
(2 hours lesson; 2 hours seminar)
This topic provides a comprehensive study of **renewable energy sources**, including **solar**, **wind**, **hydroelectric**, and **geothermal** power generation. Students will explore the principles, technologies, and applications associated with each type of renewable energy. The course covers the design and operation of renewable energy systems, their potential for reducing carbon emissions, and their role in sustainable energy strategies. Emphasis is placed on understanding the advantages, limitations, and technological advancements of each energy source, as well as their integration into existing energy infrastructures and their impact on energy efficiency and environmental conservation.

Topic IV – Grid Integration of Renewable Energy: Challenges and solutions for integrating renewable energy into existing electrical grids.
(2 hours lesson; 2 hours seminar)
This topic explores the **challenges and solutions** involved in integrating **renewable energy** sources into existing electrical grids. Students will examine issues such as **variability** and **intermittency** of renewable resources, impacts on grid stability, and the need for upgraded infrastructure. The course covers solutions like **energy storage systems**, **demand response strategies**, and **advanced grid management techniques** to ensure smooth integration. Emphasis is placed on developing strategies to enhance grid reliability, accommodate increasing shares of renewable energy, and support sustainable energy transitions while maintaining system performance and stability.

Topic V – Consumers and Electrical Power Systems .
(2 hours lesson; 2 hours seminar)
This topic examines the relationship between **consumers** and **electrical power systems**, focusing on how electrical systems are designed to meet consumer needs and demands. Students will explore the different types of consumers, including

	residential, commercial, and industrial, and how their power requirements influence system design and operation. The course covers key concepts such as **load profiling**, **demand forecasting**, and **energy consumption patterns**. Emphasis is placed on understanding how electrical power systems are structured to provide reliable and efficient service to various consumer types, and the role of consumer behavior in shaping energy strategies and system performance. **Topic VI – Energy Storage Systems: Overview of different energy storage technologies including batteries, pumped hydro, and flywheels.** (2 hours lesson; 2 hours seminar) This topic provides an **overview of various energy storage technologies**, focusing on their principles, applications, and benefits. Students will explore different types of energy storage systems, including **batteries** (such as lithium-ion and lead-acid), **pumped hydro storage**, and **flywheels**. The course covers how each technology works, their advantages and limitations, and their role in enhancing energy reliability and efficiency. Emphasis is placed on understanding how energy storage can support renewable energy integration, stabilize power grids, and provide backup power solutions, contributing to a more resilient and sustainable energy system. **Topic VII - Power Plant Safety Regulations: Understanding safety regulations and standards for electrical power plants.** (2 hours lesson; 2 hours seminar) This topic focuses on **safety regulations and standards** for **electrical power plants**, emphasizing their importance in ensuring safe and reliable plant operations. Students will explore key regulations, including those related to **equipment maintenance**, **emergency procedures**, **worker safety**, and **environmental protection**. The course covers compliance with national and international standards, such as those set by the **Occupational Safety and Health Administration (OSHA)** and **International Electrotechnical Commission (IEC)**. Emphasis is placed on understanding and implementing safety protocols to prevent accidents, manage risks, and maintain a safe working environment in power plant operations. **Topic VIII - Calculating currents in short-circuited circuits and short-circuit analysis .** (2 hours lesson; 2 hours seminar) This topic explores the methods for **calculating currents** in **short-circuited circuits** and conducting **short-circuit analysis**. Students will learn to determine the magnitude and distribution of currents when a circuit experiences a short circuit, using principles such as **Ohm's Law**, **Kirchhoff's Laws**, and **Thevenin's Theorem**. The course covers techniques for analyzing the effects of short circuits on system components, including the impact on voltage drops, power dissipation, and system protection. Emphasis is placed on practical approaches to evaluate short-circuit conditions, design appropriate protection measures, and ensure the safe operation of electrical systems. **Topic IX - Emergency Response and Evacuation Procedures: Developing emergency response plans and procedures for power plant incidents.** (2 hours lesson; 2 hours seminar) This topic focuses on **developing emergency response plans** and **evacuation procedures** for incidents in power plants. Students will learn how to create comprehensive emergency response strategies to address potential emergencies such as fires, chemical spills, or equipment failures. The course covers the development of detailed evacuation plans, coordination with emergency services, and the implementation of safety drills. Emphasis is placed on ensuring effective

communication, training personnel, and maintaining readiness to protect both plant employees and infrastructure during emergency situations.

Topic X - Electrical Safety Practices: Best practices for ensuring electrical safety in power plant environments.
(2 hours lesson; 2 hours seminar)
This topic covers **best practices for ensuring electrical safety** in power plant environments. Students will learn about critical safety protocols and procedures to prevent electrical hazards, including **proper grounding**, **use of personal protective equipment (PPE)**, and **safe work practices**. The course includes guidance on conducting risk assessments, implementing lockout/tagout procedures, and ensuring compliance with safety standards and regulations. Emphasis is placed on creating a culture of safety, providing training, and maintaining safety equipment to protect personnel and maintain a safe working environment in power plants.

Topic XI - Arc Flash Hazards and Mitigation: Understanding arc flash hazards and implementing mitigation measures in power plants.
(2 hours lesson; 2 hours seminar)
This topic explores **arc flash hazards** and **mitigation measures** in power plants. Students will learn about the causes and effects of arc flashes, including their potential to cause severe injury and damage. The course covers key concepts such as **arc flash analysis**, **personal protective equipment (PPE)**, and **engineering controls** to minimize risk. Emphasis is placed on implementing effective mitigation strategies, including **maintenance practices**, **system design modifications**, and **safety protocols** to protect personnel and ensure a safe working environment.

Topic XII - Working with Electrical Equipment and Machines
(2 hours lesson; 2 hours seminar)
This topic focuses on **best practices** and **safety protocols** for working with **electrical equipment** and **machines**. Students will learn about the safe operation, maintenance, and troubleshooting of various electrical devices and machinery. The course covers essential topics such as **equipment handling**, **proper use of tools**, **preventive maintenance**, and **safety procedures** to minimize risks. Emphasis is placed on understanding equipment specifications, implementing effective operational techniques, and adhering to safety standards to ensure safe and efficient working practices in industrial and power plant environments.

Topic XIII - Risks of Injury from Electrical Energy and Their Prevention .
(2 hours lesson; 2 hours seminar)
This topic examines the **risks of injury** associated with **electrical energy** and strategies for their prevention. Students will explore common electrical hazards such as **shock**, **burns**, and **arc flash**, and understand their potential impact on health and safety. The course covers preventive measures including **proper insulation**, **use of personal protective equipment (PPE)**, and **adherence to safety regulations**. Emphasis is placed on risk assessment, implementing safety protocols, and training to effectively minimize the likelihood of electrical accidents and ensure a safe working environment.

Topic XIV - Providing First Aid in Case of Electric Shock
(2 hours lesson; 2 hours seminar)
This topic focuses on the **first aid procedures** for managing **electric shock** incidents. Students will learn the essential steps to take immediately after an electric shock occurs, including **safety precautions**, **emergency response techniques**, and **basic life support** (BLS). The course covers how to safely disconnect the power

<table>
<tr><td></td><td>source, assess the victim's condition, perform cardiopulmonary resuscitation (CPR) if necessary, and seek medical attention. Emphasis is placed on understanding the physiological effects of electric shock, preventing further injury, and ensuring prompt and effective intervention to enhance recovery and minimize complications.</td></tr>
<tr><td>Methodology</td><td>
Learning Evaluation Methods.
Active participation in seminar classes. Two written exams: a mid-term exam and a final one.
Course assignment.

Learning Evaluation Criteria.
The evaluation aims at verifying the student's knowledge and understanding of the fundamentals.
The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course.
The highest score is achieved by demonstrating in-depth knowledge of the course contents.
Praise is given to students who are particularly brilliant in exposure and/or demonstrate mastery of the matters treated in the course, being able to analyze topics not explicitly.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise

<table>
<tr><td>Points</td><td>Exam test</td></tr>
<tr><td>91 - 100</td><td>Excellent/pass</td></tr>
<tr><td>71 - 90</td><td>Good/pass</td></tr>
<tr><td>41 - 70</td><td>Normal/pass</td></tr>
<tr><td>0 - 40</td><td>Bad/no pass</td></tr>
</table>

Final Mark Allocation Criteria.
Active participation in seminar classes
Mid-term exam
Course assignment
Final exam
</td></tr>
<tr><td>Bibliography</td><td>Leonard L.Gisby (2012), Electric Power Generation, Transmission and Distribution
John Madden (2017), Electrical Safety and the Law, Fifth Edition</td></tr>
<tr><td>Educational resources</td><td>Workstation (In all the topics).
Projector (In all the topics).
Computers. (In all the topics).
Multimeter (Topic XI).
Small solar panel educational set. (In topic VI).
Thermal imaging cameras. (In topics VI, VII and X).</td></tr>
</table>

Institution	European University of Tirana
Module (Title)	**ELECTRICAL SYSTEMS**
Full Name of the Professor	Msc. Ing. Jani Petro
Hours:	56 hours in total, 28 hours lectures and 28 hours seminars
Program	Bachelor, Integrated Diploma in Industrial Engineering, Electrical profile. 6 ECTS. 2024 – 2025, 3rd year;1st semester. Mandatory.
Learning outcomes	**Knowledge and Understanding** In the framework of the subject "Electrical Systems", students will be equipped with general knowledge of electrical equipment, with switching and protective devices in low voltage networks, with the application of the computer in the design of distribution networks, with the supply of electricity in the voltage medium, with aerial and cable electrical networks at medium voltage, with distribution panel schemes, with transformation cabins, with measuring and control devices in substations, with relay protection and automation in the electricity supply networks of urban and industrial consumers and rural, with the improvement of the power coefficient, as well as with the light technique and the calculation of lighting networks. **Capacity to apply Knowledge and Understanding** By the end of this course, students will: - be capable of applying principles and methodologies to design and implement energy-efficient electrical systems, ensuring that they meet EU energy efficiency standards and contribute to sustainable building practices. - develop the ability to critically evaluate the energy performance of electrical systems in buildings, identifying areas for improvement and making informed decisions to enhance energy efficiency while maintaining system reliability and safety. - acquire the skills to effectively communicate technical concepts and energy efficiency strategies related to electrical systems to a variety of stakeholders. - enhance their capacity for independent learning and professional development, staying updated with the latest advancements in energy-efficient technologies and regulations, and integrating this knowledge into the practice of electrical system design and management. - be able to design, analyze, and troubleshoot electrical systems specific to building applications, utilizing tools and techniques for system layout, load calculation, and integration with other building systems (e.g., HVAC, security).

	- be proficient in using software for electrical design and simulation, and in interpreting technical drawings and specifications. **Transversal Skills** - Collaborate with peers and interdisciplinary teams in measurement projects, demonstrating leadership, coordination, and problem-solving skills to achieve accurate and reliable outcomes.
Content	**Topic I – Fundamentals of Electricity** (2 hours lesson; 2 hour seminars) This topic introduces the **fundamentals of electricity**, covering essential concepts such as voltage, current, resistance, and power. **Topic II – Energy Efficiency in Electrical Systems: Techniques and strategies for improving energy efficiency in electrical systems, including optimization of power distribution and utilization.** (2 hours lesson; 2 hour seminars) This topic focuses on techniques and strategies for improving energy efficiency within electrical systems. Students will explore methods to optimize power distribution and utilization, including advanced approaches to reducing energy loss, enhancing load management, and implementing energy-efficient technologies. The course covers the application of energy-efficient practices, such as demand-side management, smart grids, and high-efficiency equipment, to improve overall system performance and sustainability. Emphasis is placed on practical strategies for reducing operational costs and environmental impact while maintaining system reliability and effectiveness. **Topic III – Methods of Electrical System Analysis** (2 hours lesson; 2 hour seminars) This topic covers various **methods of analyzing electrical systems** to ensure optimal performance and reliability. Students will learn techniques for evaluating electrical circuits and systems, including **circuit analysis**, **load analysis**, and **fault analysis**. The course includes the application of analytical tools and software for performing detailed assessments of system behavior, stability, and efficiency. Key methods such as **nodal analysis**, **mesh analysis**, and **frequency domain analysis** will be explored to understand and resolve complex electrical issues, improve system design, and enhance troubleshooting processes. **Topic IV – Power Quality and Reliability: Understanding power quality issues and reliability challenges in electrical systems, and methods for maintaining stable and reliable power supply.** (2 hours lesson; 2 hour seminars) This topic focuses on understanding power quality issues and reliability challenges in electrical systems. Students will examine factors affecting power quality, such as voltage sags, surges, harmonics, and frequency deviations, and their impact on system performance. The course will also cover strategies and methods for maintaining a stable and reliable power supply, including power conditioning, uninterruptible power supplies (UPS), and redundancy measures. Emphasis is placed on diagnosing power quality problems, implementing corrective actions, and ensuring continuous and dependable electrical service in various applications.

Topic V - Smart Grid Technologies: Overview of smart grid technologies for efficient management and control of electrical systems, including demand response, advanced metering, and distribution automation.
(2 hours lesson; 2 hour seminars)
This topic provides an overview of smart grid technologies designed to enhance the management and control of electrical systems. Students will explore key components and innovations such as demand response, which adjusts energy consumption based on grid conditions; advanced metering infrastructure (AMI), which enables real-time data collection and analysis; and distribution automation, which improves the efficiency and reliability of power distribution. The course covers how these technologies work together to optimize energy use, improve grid stability, and support the integration of renewable energy sources, contributing to a more intelligent and responsive electrical grid.

Topic VI – Three-Phase Systems
(2 hours lesson; 2 hour seminars)
This topic explores the principles and applications of **three-phase systems**, a fundamental concept in electrical engineering. Students will learn about the structure and advantages of three-phase power, including its ability to deliver more efficient and balanced electrical power compared to single-phase systems. The course covers the generation, transmission, and distribution of three-phase electricity, as well as key components such as transformers and motors. Emphasis is placed on understanding phase relationships, line and phase voltages, and the use of three-phase systems in industrial and commercial applications for improved performance and reliability.

Topic VII - Distributed Generation Systems: Study of distributed generation systems, including microgrids, and their role in enhancing energy efficiency and resilience in electrical systems.
(2 hours lesson; 2 hour seminars)
This topic examines distributed generation systems, focusing on technologies such as microgrids and their impact on energy efficiency and resilience in electrical systems. Students will explore various forms of distributed generation, including solar panels, wind turbines, and combined heat and power (CHP) systems, and how they contribute to a more decentralized and reliable energy supply. The course covers the integration of these systems into existing grids, their role in enhancing grid stability, reducing transmission losses, and supporting sustainable energy practices. Emphasis is placed on the benefits of distributed generation for improving energy security and reducing environmental impact.

Topic VIII - Power Electronics and Converters: Introduction to power electronics and converters used in electrical systems for efficient power conversion and control.
(2 hours lesson; 2 hour seminars)
This topic introduces power electronics and converters used in electrical systems to achieve efficient power conversion and control. Students will explore various types of power converters, including rectifiers, inverters, DC-DC converters, and AC-AC converters, and their roles in modifying voltage, current, and frequency to meet specific system requirements. The course covers fundamental concepts such as switching techniques, control strategies, and efficiency optimization, emphasizing the importance of power electronics in enhancing system performance, reliability, and energy efficiency across a range of applications

Topic IX - Building Energy Management Systems (BEMS): Overview of BEMS for optimizing energy usage in buildings, including HVAC systems, lighting, and appliances.
(2 hours lesson; 2 hour seminars)
This topic provides an overview of Building Energy Management Systems (BEMS), focusing on their role in optimizing energy usage within buildings. Students will explore how BEMS integrate with HVAC systems, lighting, and appliances to monitor, control, and improve energy efficiency. The course covers key components of BEMS, such as sensors, controllers, and software platforms, and their applications in tracking energy consumption, automating system operations, and implementing energy-saving strategies. Emphasis is placed on understanding how BEMS contribute to reducing energy costs, enhancing comfort, and supporting sustainability goals in building management.

Topic X - Energy Auditing and Monitoring: Methods for conducting energy audits and monitoring energy consumption in electrical systems to identify opportunities for improvement.
(2 hours lesson; 2 hour seminars)
This topic covers **methods for conducting energy audits** and **monitoring energy consumption** in electrical systems. Students will learn how to systematically evaluate energy use, identify inefficiencies, and assess opportunities for improvement. The course includes techniques for collecting and analyzing data, using energy monitoring tools, and interpreting audit results to recommend strategies for enhancing energy performance. Emphasis is placed on practical approaches to implementing energy-saving measures, reducing operational costs, and achieving sustainability objectives through effective energy management.

Topic XI - Circuits With Current Sources
(2 hours lesson; 2 hour seminars)
This topic explores **circuits with current sources**, focusing on their role and behavior in electrical systems. Students will learn how to analyze and design circuits that include ideal and practical current sources, understanding their impact on circuit performance. The course covers key concepts such as **Kirchhoff's Current Law (KCL)**, **superposition theorem**, and **Thevenin's and Norton's theorems** as they apply to circuits with current sources. Emphasis is placed on practical applications, including the use of current sources in amplifier circuits, biasing of transistors, and other electronic components.

Topic XII - Electrical System Safety
(2 hours lesson; 2 hour seminars)
This topic focuses on **electrical system safety**, emphasizing practices and standards to ensure the safe design, operation, and maintenance of electrical systems. Students will learn about **safety protocols**, **protective devices**, and **risk assessment** techniques to prevent electrical hazards such as shocks, fires, and equipment failures. The course covers essential topics including **grounding and bonding**, **circuit protection**, and **personal protective equipment (PPE)**. Emphasis is placed on compliance with safety regulations and industry standards to protect both personnel and equipment, ensuring a safe working environment in various electrical applications.

Topic XIII - Automation
(2 hours lesson; 2 hour seminars)
This topic explores the principles and applications of **automation** in various systems and industries. Students will learn about the technologies and methods used to

	automate processes, including **programmable logic controllers (PLCs)**, **sensors**, **actuators**, and **control systems**. The course covers key concepts such as **process control**, **robotics**, and **automation software**, emphasizing how automation enhances efficiency, accuracy, and productivity. Practical applications include automated manufacturing, building management systems, and industrial operations, with a focus on designing, implementing, and optimizing automated solutions to improve operational performance. **Topic XIV- Safety, Reliability, and Risk Management in Energy-Efficient Systems.** (2 hours lesson; 2 hour seminars) This topic addresses safety, reliability, and risk management in the context of energy-efficient systems. Students will explore strategies for ensuring safe and reliable operation of energy-efficient technologies, including risk assessment and mitigation techniques. The course covers the principles of system reliability, safety protocols, and risk management practices to prevent failures and enhance the longevity of energy-efficient systems. Emphasis is placed on integrating safety and reliability considerations into the design, implementation, and maintenance of energy-efficient solutions to protect both systems and users while achieving optimal performance and energy savings.
Methodology	**Learning Evaluation Methods.** Active participation in seminar classes Mid-term exam Course assignment Final exam **Learning Evaluation Criteria**. The evaluation consists first in verifying the student's knowledge and understanding of the basic functioning. The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course. The highest score is achieved by demonstrating in-depth knowledge of the course contents. Praise is given to students who are particularly brilliant in exposure and/or demonstrate mastery of the matters treated in the course, being able to analyze topics not explicitly. **Learning Measurement Criteria**. A 100-points scale is used for grading, with possible praise Points / Exam test 91 - 100 / Excellent/pass 71 - 90 / Good/pass 41 - 70 / Normal/pass 0 - 40 / Bad/no pass **Final Mark Allocation Criteria**. Active participation in seminar classes (10%) Mid-term exam (30%) Course assignment (20%) Final exam (40%)

Bibliography	Maurice Willis (2019) Electrical Systems Engineering: Design, Analysis and Implementation . Moncef Krati(2024), Energy-Efficient Electrical Systems for Buildings 2nd edition
Educational resources	Workstation (In all the topics). Projector (In all the topics). Computers. (In all the topics). DJI Mavic 3 Pro Fly More Combo (In topic VIII). Thermal imaging cameras. (In topics V and VII). Multimeter. (In topic VI).

Institution	European University of Tirana
Module (Title)	**ELECTRICAL AND ENERGY MEASUREMENTS**
Full Name of the Professor	Prof. Dr. Angjelin Shtjefni, MSc. Jani Petro, MSc. Hasimin Keçi.
Hours:	56 hours in total, 28 hours lectures and 28 hours seminars
Program	Master's degree, Mechanical Engineering. 6 ECTS / New module 2025 – 2026. 3rd year;1st semester Optional.
Learning outcomes	**Knowledge and Understanding** Throughout the course, students will: - understand the principles and methodologies of electrical and energy measurements in building systems to enhance energy efficiency **Capacity to apply Knowledge and Understanding** By the end of this course, students will: - perform precise electrical and energy measurements using advanced instrumentation to assess energy efficiency in buildings. - analyze and interpret measurement data to identify energy inefficiencies and propose corrective actions. - develop and implement energy monitoring plans to continuously improve energy efficiency in buildings. - evaluate the impact of regulatory and technological advancements on energy measurement practices and energy efficiency in buildings. **Transversal Skills** - Collaborate with peers and interdisciplinary teams in measurement projects, demonstrating leadership, coordination, and problem-solving skills to achieve accurate and reliable outcomes.
Content	**Topic I – Measuring Instruments: Classification.** (2 hours lesson; 2 hour seminars) This topic focuses on the **classification of measuring instruments**, essential for understanding their applications and capabilities. Students will explore various types of measuring instruments used in electrical and energy measurements, including **analog and digital meters**, **multimeters**, **oscilloscopes**, and **power analyzers**. The course covers the key characteristics, advantages, and limitations of each instrument type, along with their specific uses in different measurement scenarios. Emphasis is placed on selecting appropriate instruments based on

measurement requirements, accuracy, and functionality to ensure effective and reliable data collection

Topic II – Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications.
(2 hours lesson; 2 hour seminars)
This topic explores the **classification of measuring instruments**, focusing on their types and uses in electrical and energy measurements. Students will learn about various categories of instruments, including **analog** versus **digital**, **static** versus **dynamic**, and **absolute** versus **relative** measurements. The course covers key instruments such as **multimeters**, **oscilloscopes**, **wattmeters**, and **power analyzers**, detailing their functions, applications, and advantages. Emphasis is placed on understanding the appropriate selection and application of measuring instruments based on measurement requirements, accuracy, and specific use cases in various contexts.

Topic III – DC/AC Bridges.
(2 hours lesson; 2 hour seminars)
This topic examines **DC/AC bridges**, which are essential for precise electrical measurements and testing. Students will explore the principles and applications of various bridge circuits, including **Wheatstone bridges** for resistance measurement, and **AC bridges** for measuring impedance and reactance. The course covers the operation of these bridges, including their setup, calibration, and interpretation of results. Emphasis is placed on understanding how DC/AC bridges provide accurate measurements of electrical parameters, their use in diagnostic and experimental settings, and their role in ensuring precision in electrical engineering applications.

Topic IV – Block diagram, Sweep generation, vertical amplifiers, use of CRG in measurement of frequency, phase, Amplitude and rise time of a pulse.
(2 hours lesson; 2 hour seminars)
This topic covers the **block diagram** approach for understanding and designing measurement systems, focusing on **sweep generation**, **vertical amplifiers**, and the use of **Cathode Ray Generators (CRGs)** in measuring electrical signals. Students will learn about the function of each component in a measurement setup: how **sweep generators** produce time-varying signals, how **vertical amplifiers** amplify signal inputs, and how **CRGs** are utilized for accurate measurement of **frequency**, **phase**, **amplitude**, and **rise time** of a pulse. Emphasis is placed on integrating these elements to effectively analyze and interpret complex signal characteristics in various measurement applications.

Topic V – Galvanometers: General principle and performance equations of D' Arsonval Galvanometers.
(2 hours lesson; 2 hour seminars)
This topic explores the **general principle** and **performance equations** of **D'Arsonval galvanometers**, a type of sensitive instrument used to measure electrical currents. Students will learn about the operating principle of the D'Arsonval galvanometer, which involves a moving coil suspended in a magnetic field, and how it translates electrical currents into mechanical movement. The course covers key performance equations, including those related to sensitivity, deflection, and calibration, enabling students to understand and calculate the instrument's accuracy and performance. Emphasis is placed on applying these principles to effectively utilize galvanometers in various measurement scenarios.

Topic VI – Digital Multi-meter: Block diagram, principle of operation.
(2 hours lesson; 2 hour seminars)
This topic provides an overview of the **digital multi-meter (DMM)**, focusing on its **block diagram** and **principle of operation**. Students will learn about the key components and functions of a DMM, including the **analog-to-digital converter (ADC)**, **display unit**, and **measurement circuitry**. The course covers how a DMM measures various electrical parameters such as voltage, current, and resistance by converting analog signals into digital values for accurate readings. Emphasis is placed on understanding the internal workings of the DMM, interpreting its block diagram, and applying its measurement capabilities in practical scenarios.

Topic VII - Voltmeter: Transistor Voltmeter, Block diagram.
(2 hours lesson; 2 hour seminars)
This topic focuses on the **transistor voltmeter (TVM)**, including its **block diagram** and operational principles. Students will learn about the key components of a transistor voltmeter, which uses transistors to amplify the input voltage and provide accurate measurements. The course covers the main blocks of the TVM, such as the **input stage**, **amplification stage**, and **display unit**. Emphasis is placed on understanding how each component functions within the block diagram and how the TVM converts electrical voltage into a readable output, enhancing measurement accuracy and versatility.

Topic VIII - Ammeters, voltmeters: (DC/AC) PMMC.
(2 hours lesson; 2 hour seminars)
This topic covers **ammeter** and **voltmeter** devices utilizing **Permanent Magnet Moving Coil (PMMC)** technology for both **DC** and **AC** measurements. Students will learn about the operation and principles of PMMC instruments, which use a moving coil within a permanent magnet field to measure current (ammeters) and voltage (voltmeters). The course includes an exploration of the characteristics and advantages of PMMC meters, such as high accuracy and linearity for DC measurements, and how they are adapted for AC measurements using additional components like rectifiers. Emphasis is placed on understanding the construction, calibration, and application of PMMC meters in various electrical measurement scenarios.

Topic IX - Electrodynamometer type.
(2 hours lesson; 2 hour seminars)
This topic explores the **electrodynamometer type** of measuring instrument, which is used for accurate measurement of electrical power, current, and voltage. Students will learn about the operating principles of electrodynamometers, which use the interaction between magnetic fields generated by current-carrying coils to produce a measurable deflection. The course covers the construction and key components, such as the fixed and moving coils, and their role in providing precise measurements. Emphasis is placed on understanding the electrodynamometer's applications in both AC and DC circuits, its advantages in terms of accuracy and linearity, and its role in various electrical measurement and calibration tasks.

Topic X - Potentiometers: DC Potentiometer.
(2 hours lesson; 2 hour seminars)
This topic focuses on the **DC potentiometer**, a precision instrument used for measuring and calibrating direct current (DC) voltages. Students will learn about the principle of operation of DC potentiometers, which involve comparing an unknown voltage to a known reference voltage using a variable resistor (potentiometer). The course covers the key components, including the **null detector**, **reference voltage**

	source, and **precision resistors**, as well as the process of achieving accurate voltage measurements through balance and adjustment. Emphasis is placed on understanding the DC potentiometer's applications in accurate voltage measurement and calibration, as well as its advantages in achieving high precision in electrical testing. **Topic XI - Material and energy balances at process and plant level: Plant as an energy system; Methods for preparing flow charts in processes, balance of masses and energy.** (2 hours lesson; 2 hour seminars) This topic examines **material and energy balances** at both the **process** and **plant** levels, focusing on the plant as an **energy system**. Students will learn methods for preparing **flow charts** to visualize and analyze process flows and interactions. The course covers the fundamental principles of **mass balance** and **energy balance**, including how to account for all inputs, outputs, and transformations within a system. Emphasis is placed on understanding how to apply these balances to optimize processes, improve efficiency, and ensure sustainable energy management within industrial plants. **Topic XII - AC Potentiometer.** (2 hours lesson; 2 hour seminars) This topic covers the **AC potentiometer**, a precision instrument used to measure alternating current (AC) voltages and calibrate AC circuits. Students will learn about the operation of AC potentiometers, which involve comparing an unknown AC voltage to a known reference voltage by adjusting a variable resistor to achieve a balance. The course includes an exploration of the key components, such as the **variable resistor**, **reference voltage source**, and **null detection system**. Emphasis is placed on understanding the AC potentiometer's role in achieving accurate AC voltage measurements, its application in calibration and testing, and its advantages in providing high precision in AC voltage measurements. **Topic XIII - Wattmeters: Electrodynamometer.** (2 hours lesson; 2 hour seminars) This topic explores the **electrodynamometer type wattmeter**, a precision instrument used to measure electrical power in AC circuits. Students will learn about the operating principle of electrodynamometer wattmeters, which utilize the interaction between magnetic fields generated by current-carrying coils to measure power. The course covers the design and key components, including the **fixed and moving coils**, **shunt resistors**, and **calibration techniques**. Emphasis is placed on understanding how electrodynamometer wattmeters provide accurate power measurements, their advantages in terms of high precision and linearity, and their applications in various electrical power measurement tasks. **Topic XIV - Linear Variable Differential Transformer (LVDT).** (2 hours lesson; 2 hour seminars) This topic covers the **Linear Variable Differential Transformer (LVDT)**, an electromechanical device used for precise linear position measurement. Students will learn about the operating principle of the LVDT, which involves a movable core and three coaxial coils to detect displacement by generating differential voltage signals. The course includes an exploration of the LVDT's construction, including the **primary coil** and **two secondary coils**, as well as its advantages in terms of high accuracy, linearity, and durability. Emphasis is placed on understanding the LVDT's applications in industrial and research settings for measuring linear displacement and its role in providing reliable and precise measurement data.

<table>
<tr>
<td>Methodology</td>
<td>
Learning Evaluation Methods.

Active participation in seminar classes
Mid-term exam
Course assignment
Final exam

Learning Evaluation Criteria.
The evaluation consists first in verifying the student's knowledge and understanding of the basic functioning.
The outcome of the evaluation is positive if the student proves to have the basic knowledge of all subjects covered in the course.
The highest score is achieved by demonstrating in-depth knowledge of the course contents.
Praise is given to students who are particularly brilliant in exposure and/or demonstrate mastery of the matters treated in the course, being able to analyze topics not explicitly.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise
<table>
<tr><td>Points</td><td>Exam test</td></tr>
<tr><td>91 - 100</td><td>Excellent/pass</td></tr>
<tr><td>71 - 90</td><td>Good/pass</td></tr>
<tr><td>41 - 70</td><td>Normal/pass</td></tr>
<tr><td>0 - 40</td><td>Bad/no pass</td></tr>
</table>
Final Mark Allocation Criteria.
Active participation in seminar classes (10%)
Mid-term exam (30%)
Course assignment (20%)
Final exam (40%)
</td>
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<tr>
<td>Bibliography</td>
<td>A Course in Elec. & Electronics Measurements & Instrumentation: A K. Sawhney, Blueprint, London 2017;
Modern Electronic Instrumentation and Measurement Techniques: Helfrick & Cooper, Blue Print, London 2021.</td>
</tr>
<tr>
<td>Educational resources</td>
<td>Desktop computers able to run software for simulations. (In all the topics).
Workstation to process 3D images and virtual simulations. (In topic IV and topic XI)
Projector to support online teaching and laboratory activities. (In all the topics).
Thermal imaging cameras.(In topic XI).
DJI Mavic 3 Pro Fly More Combo (In topic VI).
Multimeter (In all the topics).</td>
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MODULE: ENERGY MANAGEMENT

Institution	European University of Tirana
Module (Title)	**ENERGY MANAGEMENT**
Full Name of the Professor	Prof. Dr. Angjelin Shtjefni, MSc. Hasimin Keçi
Hours:	42 hours in total, 28 hours lectures and 14 hours seminars
Program	Master's degree, Mechanical Engineering. 6 ECTS / New module 2025 – 2026; 2nd year; 2nd semester Optional.
Learning outcomes	**Knowledge and Understanding** Throughout the course, students will: - understand the fundamental principles and methodologies of energy management. **Capacity to apply Knowledge and Understanding** By the end of this course, students will be: - able to apply energy management techniques to optimize energy use in various settings; - able to design and implement comprehensive energy management plans. - able to lead energy management projects and initiatives; - able to evaluate the impact of energy management policies and technologies on organizational performance; **Transversal Skills** - Collaborate with multidisciplinary teams on energy management projects, demonstrating leadership, coordination, and problem-solving skills to achieve energy efficiency goals.
Content	**Topic I – Definition & Objectives of Energy Management** (2 hours lesson; 2 hour seminars) This topic introduces the **definition** and **objectives** of **energy management**, focusing on its role in optimizing energy use and improving efficiency within organizations. Students will explore the core principles of energy management, including the systematic approach to planning, monitoring, and controlling energy consumption. The course covers key objectives such as reducing energy costs, minimizing environmental impact, and ensuring compliance with regulations. Emphasis is placed on understanding how effective energy management supports sustainability goals, enhances operational efficiency, and contributes to overall organizational performance

Topic II – Energy Audit: Types and Methodology
(2 hours lesson; 2 hour seminars)
This topic explores **energy audits**, focusing on the different **types** and **methodologies** used to assess and improve energy efficiency in organizations. Students will learn about the various types of energy audits, including **preliminary audits**, **detailed audits**, and **investment-grade audits**, each with specific scopes and objectives. The course covers the systematic methodology for conducting energy audits, including **data collection**, **analysis of energy use**, **identification of energy-saving opportunities**, and **recommendation of improvement measures**. Emphasis is placed on understanding how to perform effective energy audits to evaluate current energy performance, develop strategies for energy conservation, and support overall energy management goals.

Topic III – Energy Audit Reporting Format
(2 hours lesson; 2 hour seminars)
This topic focuses on the **format** and **structure** of **energy audit reports**, which are essential for documenting findings and recommendations from energy audits. Students will learn about the key components of an effective energy audit report, including **executive summaries**, **detailed findings**, **energy consumption analysis**, and **recommendations for improvements**. The course covers how to present data clearly and concisely, ensuring that reports are understandable and actionable for stakeholders. Emphasis is placed on structuring reports to highlight critical insights, provide a clear path for implementation, and support decision-making processes in energy management.

Topic IV – Understanding Energy Costs
(2 hours lesson; 2 hour seminars)
This topic delves into the concept of **energy costs**, including the factors that influence them and methods for analyzing and managing these expenses. Students will explore the different components of energy costs, such as **energy rates**, **demand charges**, and **fixed vs. variable costs**. The course covers how to interpret energy bills, evaluate cost structures, and identify opportunities for cost savings through efficient energy use and procurement strategies. Emphasis is placed on understanding the financial impact of energy consumption, the role of energy management in reducing costs, and strategies for optimizing energy expenditures to achieve economic and environmental benefits.

Topic V – Matching Energy Usage to Requirement
(2 hours lesson; 2 hour seminars)
This topic explores strategies for **matching energy usage to requirements**, aiming to optimize energy efficiency and reduce waste. Students will learn how to analyze and align energy consumption with actual needs, including techniques for **load profiling**, **demand forecasting**, and **energy load management**. The course covers methods to accurately assess energy requirements for different processes and applications, ensuring that energy supply is appropriately scaled to match usage patterns. Emphasis is placed on implementing solutions that adjust energy usage to demand, enhancing efficiency, and minimizing energy waste to achieve both cost savings and environmental benefits.

Topic VI – Maximizing System Efficiency
(2 hours lesson; 2 hour seminars)
This topic focuses on **maximizing system efficiency** through various optimization techniques and strategies. Students will learn how to enhance the performance of energy systems by analyzing and improving system components and operations. The

course covers methods for identifying inefficiencies, implementing energy-saving measures, and optimizing system design and operation. Key topics include **performance benchmarking**, **system upgrades**, and **preventive maintenance**. Emphasis is placed on achieving optimal efficiency to reduce energy consumption, lower operational costs, and improve overall system performance, contributing to both economic and environmental benefits.

Topic VII - Fuel and Energy Substitution
(2 hours lesson; 2 hour seminars)
This topic examines **fuel and energy substitution** as strategies for transitioning to alternative energy sources and reducing reliance on traditional fuels. Students will explore the principles and benefits of replacing conventional fuels with more sustainable options, such as **renewable energy sources** (solar, wind, bioenergy) or **alternative fuels** (natural gas, hydrogen). The course covers the process of evaluating and implementing substitution strategies, including **cost analysis**, **environmental impact assessments**, and **feasibility studies**. Emphasis is placed on understanding how fuel and energy substitution can enhance sustainability, improve energy security, and achieve economic and environmental goals.

Topic VIII - Energy use in buildings: Physical principles. The thermal envelope of the building and the role of shape, size and orientation. Heating and cooling and their systems
(2 hours lesson; 2 hour seminars)
This topic explores the **physical principles** underlying **energy use in buildings**, focusing on key aspects of the **thermal envelope** and the impact of **shape, size, and orientation**. Students will learn how the building's design influences energy efficiency, including how thermal envelope (walls, windows, roofs) affects heat retention and loss. The course covers the principles of **heating and cooling** systems, including different types of systems (e.g., HVAC, radiant heating) and their efficiency. Emphasis is placed on understanding how building design and energy systems interact to optimize energy use, improve comfort, and reduce operational costs.

Topic IX - Energy saving in new advanced buildings and the role of the design process in energy conservation in buildings. Energy saving in existing buildings through restructuring type interventions.
(2 hours lesson; 2 hour seminars)
This topic addresses **energy saving** strategies for both **new advanced buildings** and **existing structures**. Students will explore how innovative design approaches and advanced technologies in new buildings contribute to **energy conservation**, including the integration of **high-performance materials**, **efficient systems**, and **sustainable design principles**. The course also covers **energy-saving interventions** for existing buildings, such as **retrofitting**, **renovations**, and **system upgrades** aimed at improving energy efficiency. Emphasis is placed on understanding the role of the **design process** in optimizing energy use throughout the building lifecycle and implementing effective solutions for enhancing energy performance in both new and existing buildings.

Topic X - The concept of "Green" buildings. Energy performance of buildings. Concept for buildings "Nearly zero energy". Use of renewable energy in buildings.
(2 hours lesson; 2 hour seminars)
This topic explores the concept of "Green" buildings, focusing on their energy performance, the principles behind "Nearly Zero Energy" buildings, and the use of

	renewable energy in building design. Students will learn about the key features that define green buildings, such as sustainable materials, energy-efficient systems, and environmental impact reduction. The course covers the criteria for achieving nearly zero energy status, including strategies for maximizing energy efficiency and integrating renewable energy sources like solar panels and wind turbines. Emphasis is placed on understanding how these concepts contribute to reducing a building's carbon footprint, enhancing sustainability, and achieving long-term energy savings. **Topic XI - – Material and energy balances at process and plant level: Plant as an energy system; Methods for preparing flow charts in processes, balance of masses and energy** (2 hours lesson; 2 hour seminars) This topic delves into **material and energy balances** within a **plant** or **process**, viewing the plant as an integrated **energy system**. Students will learn methods for preparing **flow charts** to visualize and analyze the flow of materials and energy through different processes. The course covers the principles of **mass balance** and **energy balance**, focusing on how to account for all inputs, outputs, and transformations within a system. Emphasis is placed on applying these balances to optimize process efficiency, manage resources effectively, and enhance overall plant performance. **Topic XII - Evaluation of energy performance of utility thermal equipment in industry: Thermal insulation and refractory materials** (2 hours lesson; 2 hour seminars) This topic focuses on the **evaluation of energy performance** for **utility thermal equipment** used in industrial settings, with particular emphasis on **thermal insulation** and **refractory materials**. Students will learn how to assess the effectiveness of these materials in improving the energy efficiency of thermal systems, such as **boilers**, **furnaces**, and **heat exchangers**. The course covers methods for evaluating insulation performance, understanding its impact on heat loss reduction, and ensuring proper maintenance of refractory materials to withstand high temperatures. Emphasis is placed on strategies for optimizing thermal management, reducing energy consumption, and enhancing the overall efficiency of industrial thermal processes. **Topic XIII - Energy monitoring and targeting: Definition of monitoring-targeting, elements of monitoring-targeting, analysis of data and information, dependence "Energy consumption - Production volume"** (2 hours lesson; 2 hour seminars) This topic introduces the concepts of **energy monitoring** and **targeting**, focusing on their importance in optimizing energy use within organizations. Students will learn the definition of monitoring and targeting, along with the key elements involved in establishing an effective energy management system. The course covers methods for **data collection**, **analysis of energy consumption patterns**, and the relationship between **energy consumption and production volume**. Emphasis is placed on how to use monitoring and targeting techniques to identify energy-saving opportunities, set performance benchmarks, and implement strategies for reducing energy costs while improving operational efficiency. **Topic XIV - Economic evaluation of measures to improve energy efficiency. Techniques for financial analysis: simple payback period, return on investment, net present value, internal rate of return, cash flows, risk analysis and sensitivity. Energy performance contracts and the role of ESCOs** (2 hours lesson; 2 hour seminars)

<table>
<tr><td></td><td>This topic explores the economic evaluation of measures aimed at enhancing energy efficiency. Students will learn various financial analysis techniques to assess the viability of energy improvement projects, including simple payback period, return on investment (ROI), net present value (NPV), internal rate of return (IRR), and cash flow analysis. The course also covers risk analysis and sensitivity analysis to evaluate the impact of uncertainties on financial outcomes. Additionally, students will gain insights into energy performance contracts (EPCs) and the role of Energy Service Companies (ESCOs) in implementing and financing energy efficiency projects. Emphasis is placed on how to make informed decisions based on economic evaluations to optimize energy investments and achieve financial and environmental benefits.</td></tr>
<tr><td>Methodology</td><td>Learning Evaluation Methods.
Active participation in seminar classes
Mid-term exam
Course assignment
Final exam

Learning Evaluation Criteria.
The evaluation consists first in verifying the student's knowledge and understanding of the fundamentals.
The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course.
The highest score is achieved by demonstrating in-depth knowledge of the course contents.
Praise is given to students who are particularly brilliant in exposure and/or demonstrate mastery of the matters treated in the course, being able to analyze topics not explicitly.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise

<table>
<tr><td>Points</td><td>Exam test</td></tr>
<tr><td>91 – 100</td><td>Excellent/pass</td></tr>
<tr><td>71 – 90</td><td>Good/pass</td></tr>
<tr><td>41 – 70</td><td>Normal/pass</td></tr>
<tr><td>0 – 40</td><td>Bad/no pass</td></tr>
</table>

Final Mark Allocation Criteria.
Active participation in seminar classes (10%)
Mid-term exam (30%)
Course assignment (20%)
Final exam (40%)</td></tr>
<tr><td>Bibliography</td><td>Energy management handbook, John Wiley, and Sons - Wayne C. Turner, Blueprint, London 2018.
Guide to Energy Management, Cape Hart, Turner and Kennedy, Blue Print, London 2021.</td></tr>
<tr><td>Educational resources</td><td>Small portable solar panel test benches. (In topic IX).</td></tr>
</table>

	Desktop computers able to run software for simulations. (In all the topics). Workstation to process 3D images and virtual simulations. (In topic XI, XII and XIII). Projector to support online teaching and laboratory activities. (In all the topics). Thermal imaging cameras.(In topic XI). Multimeter. (In topic VIII).

Annex 2: Polis University (U_POLIS)

MODULE: BUILDING MATERIALS AND CONSTRUCTIVE TECHNIQUES

Institution	Polis University
Module (Title)	**BUILDING MATERIALS AND CONSTRUCTIVE TECHNIQUES**
Full Name of the Professor	Klodjan Xhexhi
Hours:	Total Class Hours: 60 hours Lectures: 36 hours Seminars/ Workshop: 24 hours
Program	- Integrated Master in Architecture and Urban Design - Second Academic year, First semester, October to February 2024-2025 - 6 ECTS - Mandatory
Learning outcomes	**Knowledge and understanding** - In-depth knowledge of understanding of the fundamental building materials (and beyond). - In-depth knowledge of building materials applications, their implementation in buildings, and their techniques of production. - In-depth knowledge of materials' chemical physical and mechanical characteristics - In-depth knowledge of concrete as a primary building material. - Critical awareness regarding the materials of construction and a wider multidisciplinary context of their applications or other program outcomes. - Critical awareness of complex problems that require innovative solutions. **Capacity to apply knowledge and understanding** <u>Engineering Analysis</u> - Ability to analyze the main properties of construction materials such as their physio-mechanical properties, and chemical and physio-chemical properties. - Ability to adapt innovative work or study environments that are complex and unpredictable and require new strategic approaches. - Ability to analyze new and complex building materials, their processes, and technologies of production through laboratory practices and new instruments. - Ability to select and apply the most appropriate building material according to the circumstances through experimental or innovative methods of problem-solving. <u>Engineering Design</u> - Ability to develop throughout experiments different types of building materials (composite materials). - Ability to understand the involvement of other fields of study such as economics, physics, chemistry, and engineering. - Ability to understand the properties of composite materials and apply it to solve design challenges.

	Investigations - Ability to investigate, identify, and obtain the required data for new and composite building materials through lab practices and new instruments. - Ability to investigate the applications of new emerging technologies in the field of materials of construction. - Ability to identify, locate, and obtain required data from the experiment sources in the laboratory in order to draw conclusions. **Transversal skills** Making Judgement - Ability to formulate judgments from incomplete or limited information. - Capability to analyze problems, think critically, and propose creative approaches to overcome challenges on building materials. - Ability to absorb the problem-solving skills required in research and innovation, develop new knowledge and procedures, and integrate knowledge from different fields Communication and team working - Ability to develop communicative, intellectual, and professional skills as well as critical awareness in the field - Ability to articulate their ideas, listen actively to others, and express themselves clearly both verbally and in writing. - Ability to include communicating technical concepts in a way that everyone on the team can understand. - Ability to share responsibilities, coordinate tasks, and work towards common goals. - Ability to be open to others' perspectives and feedback. Lifelong Learning - Ability to adapt to changing circumstances and new information engaging in independent life-long learning. - Ability to be flexible in their approach, willing to adjust plans as needed, and to be able to work effectively in evolving environments.
Content	Topic 1: Introduction to building materials. Categorization (3 h Lecture) -General knowledge of building materials. Perception of building materials. The sense of sight, hearing, touch, temperature perception, transparency, size, color as well as smells in building materials. Requirements that construction materials must meet. Informing students about the types of categorizations of building materials. Mechanical properties of building materials. -Circular economy on building materials, sustainability focus, circular model vs linear model, design for deconstruction, use of sustainable materials, reclaimed wood, recycled metals, innovative bio-based materials with a lower environmental impact, minimize environmental footprint; economic resilience and innovation; markets and job opportunities focused on sustainable practices. *Seminars:* *-Task 1: The students are required to make a video of 3-5 minutes in the context of the city of Tirana about a topic related to construction materials applied in different buildings.*

Topic 2. Physical and chemical properties of building materials.
(3 h Lecture / 1 h Workshop / Seminar)
-The main properties of construction materials and their groups. Macrostructure, microstructure, and internal structure of materials. Chemical, and mineralogical composition as well as their phase composition. Physical properties of building materials, density, volumetric mass, material compactness, porosity, water absorption, water resistance, water permeability, gas permeability, deformations from moisture, frost resistance, heat conductivity, heat capacity, fire resistance, and acoustic properties of materials.
-Heat Conductivity (Thermal Conductivity), Heat Capacity (Thermal Capacity), High heat capacity materials (Importance for thermal mass in buildings, reducing heating and cooling demands)
Acoustic Properties: Sound Absorption. Sound Insulation.

Seminar and Lab work:
-Discussions, and consultations.
-Lab: Hygrometer measurements in different building materials. The norms of moisture level of the materials in the indoor environments.

Topic 3. Classification of natural rocks. Natural stone. Examples of implementation.
(3 h Lecture / 1 h Workshop / Seminar)
-Natural stone and its characteristics. Natural stone materials. Igneous, sedimentary, metamorphic rocks and their characteristics. The processes of formation, and extraction as well as their uses in practice through technological processes. Types and composition of rocks.-
-Composite materials, reinforcements, polymers, resins, resistance, thermal properties, acoustic properties, traditional natural stones, energy efficiency, sound insulation, waste reduction and recycling, environmental impact.

Seminar and Lab work
-Presentation of videos
-Lab: Grinding various materials natural stone based for different purposes. Determination of the level of porosity and the dimension of the final granules of the natural stones and their usage.

Topic 4. Concrete elements and their components.
(3 h Lecture / 1 h Workshop / Seminar)
-Concrete and its impact on global warming. Concrete components. Physical-mechanical-chemical characteristics. The influence of shape on concrete structures. Ductility, dynamic forces, resistance, consistency, deformation time. Types of concrete according to the EC2 standard. Tests for determining concrete parameters. Concrete typologies. Wood concrete, ecological concrete, lightweight, polymer-impregnated, fiber-reinforced, refractory, antacid, RPC, self-compacting, decorative, transparent, and waterproof, as well as for industrial floors. Concrete aggregates. Gypsum-concretes, gas-concretes, and their production technologies.

Seminar:

-Lab: Preparation of wood concrete, normal concrete, or plastic-based concrete in the lab using a Wood chipper for sawdust and Shredder Plastic Materials appliance and other components.
-Task 2. Powerpoint presentation of different building materials. The students will be split into groups of 5-6 students.
-Task 3: Group research for materials: Concrete; metals; wood; composites; bituminous materials; polymers; fibers; ceramic materials (bricks).

Topic 5. Site visit
(2 h Workshop)
-Site visits. Altea Laboratory. Students will assist in the relevant tests of some concrete samples in order to test their physical-mechanical characteristics. Also, they will get relevant knowledge of the composition of concrete and its aggregates. Tensile tests will be carried out in the laboratory for steel bars as well.

Topic 6 Metals. Steel, steel structures, and steel reinforcement.
(3 h Lecture / 1 h Workshop / Seminar)
-Metals. Steel, steel structures, and steel reinforcement. Optimization of structures, and minimum surfaces. Composition, resistance, grades, alloys, ductility, strain time, imperfections, temperature, types of loads, corrosion, fire. Production technologies. Physical-mechanical-chemical characteristics. Annealing, tempering, processing, and their resistance.
-Composite metal materials, advantageous properties, performance, applications. Carbon fibers, advantageous properties: high strength-to-weight ratio, extended life span, enhanced toughness…

Topic 7 Glass, production technologies, and products.
(3 h Lecture / 2 h Workshop / Seminar)
-Glass production technologies and products. The first traces of glass. Properties of glass. Diversification phenomenon and applications. Glass raw materials, components, subcategories. Glass qualities. Stabilizing components, and auxiliary components. Classification of glasses. Crystallization of glass. Production and processing of glass. Glass typologies. Physical-mechanical-chemical properties of glass. Their classification.
-Composite materials, glass, benefits, strengths, their enhanced performance, their applications, glass fibers, embedded, polymers, resistance to high temperatures, chemical resistance, resistance to harsh environments, chemical processing, electrical insulators, electrical applications, insulation, protection, electrical currents, transparency, aesthetic qualities, strength, durability, architectural facades, windows, decorative elements.

Seminar:
-Presentation of building materials

Topic 8. Binding materials (lime, plaster, cement, bitumen)
(3 h Lecture / 2 h Workshop / Seminar)
-Inorganic binding materials. Hardening process. Air binding, hydraulic and autoclave hardening connections. Lime: physical-mechanical-chemical characteristics, production, processing, and its use. Gypsum-based binding materials (plaster). Divisions of gypsum materials. Production, grinding, and types of plaster.

Improving the physico-mechanical properties of plaster. Chemical reaction of gypsum hydration. Portland cement and its chemical composition. Modulation, production, hardening, resistance, grades, heat of hydration, types of cement. Bituminous materials. Natural bitumen, asphalt formations, petroleum bitumen, Tar. Solids, resins, oils. Waterproofing materials in rolls. Waterproofing with PVC and bi-component.

Seminar:
-Presentation of building materials

Topic 9. Site visit
(2 h Workshop)
-Site visit to one of the quarries in Fushë-Krujë. Students will be introduced to the technological processes of stone processing, from extraction from the quarry, and its breaking and shredding to the final product.

Topic 10. Ceramic materials and products. Bricks.
(3 h Lecture / 2 h Workshop / Seminar)
-Ceramic materials. Their classification. Synthesis process. Categorization depending on the structure. Porous and compact ceramic materials. Case studies of their use. Clays and their classification. Their physical-mechanical-chemical properties. Plasticity, grain composition, chemical composition. Drying and firing of clays. Production technology of ceramic materials. Brick and tile typologies. Stoneware and porcelain. Their characteristics. The mosaics.
-Composite ceramic materials, robustness, advanced materials, enhanced safety and protection for residential buildings and commercial ones, sound insulation, noise reduction, materials sound absorption, recycled materials, eco-friendly binders, environmental impact reduction.

Seminar:
-Task: exercises
Concrete composition design
Calculation of thermal losses in masonry

Topic 11. Wood materials and products
(3 h Lecture / 2 h Workshop / Seminar)
-Wooden materials and products. History of wood use. Advantages and disadvantages of wood. Macro and microstructure of wood. Log construction. Main types of timber. Physical properties of wood. Balancing moisture. Thermal conductivity. Mechanical properties. Timber defects. Natural and artificial drying of wood.
-Composite wood materials, wood engineering, natural wood fibers synthetic materials, particleboard, MDF, plywood, CLT, applications due to varying climates, recycled wood fibers sustainability and reduced waste.

Seminar:
-Mix design. Exercises, consultations
-Lab: Water content examination of different types of wood (most popular woods in Albania) using a Hygrometer instrument.

	Topic 12: Plastics, textiles and membranes (3 h Lecture / 2 h Workshop / Seminar) -Plastic materials and products. Production of plastic materials from natural resins, polymers and synthetic materials. Plastic binders. Fillers. Plasticizers. Catalysts. Stabilizers. Membranes, ETFE membranes and their characteristics. -Composite plastic materials, advantageous properties, high-performance products, recycled plastics, eco-friendly additives, environmental impact, sustainable manufacturing. *Seminar:* *-Mix design. Exercises, consultations* *-Lab: Plastic recycling processes using Shredder Plastic Materials.* Topic 13. Smart materials (3 h Lecture / 2 h Workshop / Seminar) -Types of smart materials. Sensitivity from external stimuli of smart materials. Stress, temperature, humidity, PH, electric field, magnetic field, light level. Characteristics of smart materials. Classification and applications of smart materials. Piezoelectric, electro-strictive, magneto-strictive, thermoelectric materials, shape memory bonding, electrorheological fluids, chromogenic materials, thermochromic materials, photochromic materials, electrochromic materials. *Seminar:* *-Mix design. Exercises, consultations* *-Lab: Piezoelectric materials. Experiment to prove how can we collect electricity from Piezoelectric material.* Topic 14. Site visit. (2 h Workshop) *-Site visit: Contemporary buildings in the city of Tirana. Students will be introduced to the innovative materials used as well as their implementation technologies.* Topic 15 (3 h Lecture / 2 h Workshop / Seminar) Consultation – for each topic Final revision of exercises and lectures.
Methodology	**Learning Evaluation Methods**. Attendance and participation during lectures and seminars. Two presentations during classes which will consist of structured discussions between the lecturer and the students. Homework and a written exam in class. **Learning Evaluation Criteria**. The students will be evaluated related to: - Knowledge of Materials: Assessment of students' understanding of different construction materials, their properties, and applications in various building contexts. - Material Selection: Evaluation of students' ability to choose appropriate materials based on performance, sustainability, cost, and environmental impact.

- Practical Application: Measurement of skills in applying material knowledge to real-world scenarios.
- Testing and Analysis: Assessment of students' proficiency in conducting tests on materials to evaluate strength, durability, and suitability for specific uses.
- Innovative Use: Evaluation of creativity in proposing innovative uses or combinations of materials in design solutions.
- Sustainability Awareness: Assessment of understanding sustainable practices in material selection and construction methods.
- Presentation Skills: Evaluation of clarity and effectiveness in communicating material choices and their implications through reports or presentations.

At the Final test, students will be evaluated based on their understanding of the lectures and the exercises completed throughout the course.

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Points	Grades
94-100	10
83-93	9
75-82	8
65-74	7
55-64	6
50-54	5
0-49	4

Final Mark Allocation Criteria.

-Continuous evaluation (60%):

Participation 10%,
Presentation no. 1 weight 15%,
Presentation no. 2 weight 15%,
Homework weight 20%

-Final exam weight 40%

Bibliography

Required:

- Merita Guri; Msc. Aguljen Marku, Materiale ndertimi dhe teknkina konstruktive.
- Fisnik Kadiu; Erdit Leka; Mentor Balilaj; Driton R.Kryeziu, Shkenca dhe teknollogjia e materialeve.
- O. Marku, Material ndertimi.
- Klodjan Xhexhi, The impact of building materials in inhabitance lifestyle. Case of Kruja, Albania. ISBN-13: 978-1639028627

Recommended:

- Mike Ashby and Kara Johnson, Materials and Design. The art and science of material selection in product design. ISBN 0-7506-5554-2
- Axxel Ritter, Smart materials in architecture, interior architecture and design. ISBN-13: 978-3-7643-7326-9
- Micheal Fazio; Marian Moffet; Lawrence Wodehouse, A world history of architecture.

	- Ali Muka; "Banesa fshatare dhe familja e madhe", Akademia e Shkencave, Instituti I kulturës popullore, Tiranë 2001
Educational resources	Equipment: 1. Hygrometer (Tool to measure the moisture level of the materials and water infiltration in building envelope layers). Equipment purchased with the reZEB budget 2. Grinding various materials 3. Shredder Plastic Materials 4. Wood chipper for sawdust 5. Stand mixer

Institution	Polis University
Module (Title)	**BUILDING RETROFIT STRATEGIES FOR SUSTAINABLE URBAN REGENERATION (BRS-SUR)**
Full Name of the Professor	PhD. Klodjan Xhexhi; MSc. Fulvio Papadhopulli
Hours:	Total Class Hours: 62 hours Lectures: 24 hours Studio Workshop + Reviews: 38 hours
Program	- Integrated Master in Architecture and Urban Design - (3th year) 2025-2026. First Semester - 6 ECTS / New module - Optional
Learning outcomes	**Knowledge and understanding** - Understand the historical evolution and theoretical underpinnings of building retrofit, with a focus on sustainable practices and their relevance in the context of the Western Balkans, with focus on Tirana, Albania. - Comprehensive grasp of the socio-economic, environmental, and technological factors driving retrofit initiatives in the EU as well as around the world. - Awareness for the wider multidisciplinary context of engineering and of knowledge issues at the interface between different fields. **Capacity of applying Knowledge and Understanding** <u>Engineering Analysis</u> - Ability to analyse and solve complex engineering problems based on the specialized knowledge of the principles underlying building retrofit, including structural assessment, energy efficiency improvement, and material technology. - Ability to analyse the strategic importance of retrofitting in extending the lifespan of buildings, enhancing their functionality, and contributing to urban sustainability and apply it in building solutions. - Ability to identify, formulate and solve complex problems in new and emerging areas of their specialization. <u>Engineering Design</u> - Develop a robust understanding of computational design methodologies and their application in building retrofit, specifically through the use of Grasshopper for Rhino - modelling software, and Design Builder Software (Advanced building performance simulation tool), to conduct energy modelling, structural analysis, and optimization of retrofit strategies. - Ability to use the acquired knowledge about the latest materials and technologies for building retrofit, including their properties, applications, and impact on sustainability, comfort, and energy performance to improve the design of complex retrofits.

	Investigations - Ability to conduct thorough assessments of existing buildings, identifying retrofit needs and opportunities through structural analysis and energy modeling, utilizing computational design tools in given buildings. Engineering Practice - Apply knowledge of retrofit principles and computational design methods to develop or speculate on innovative retrofit solutions. - Create designs that optimize building performance, meet sustainability criteria, and respect the architectural heritage and context of Tirana. - Capacity to select appropriate materials and technologies for retrofit projects, based on an understanding of their sustainability, performance, and aesthetic implications. **Transversal skills** Making Judgement - Develop critical thinking skills to evaluate retrofit strategies, solve complex design problems, and make informed decisions that balance technical requirements, sustainability goals, and aesthetic considerations. - Integrating knowledge from architecture, engineering, materials science, and environmental studies, to address the multifaceted challenges of building retrofit. Communication and team working - Ability to use communication skills, both verbal and visual, to effectively present retrofit designs and strategies to diverse audiences, including clients, peers, and the broader community. - Improving ethical and social responsibility by designing retrofit solutions and exchanging ideas within the group that contribute positively to the environment, respect cultural heritage, and promote social well-being. - Ability to effectively work within interdisciplinary teams Lifelong Learning - Ability to understand the importance of lifelong learning and professional development, recognizing the rapidly evolving nature of building technologies and the importance of staying abreast of advancements in the field and so to undertake further studies autonomously
Content	Topic 1. Introduction to Urban Regeneration and Retrofit Strategies. (2h - Lectures / 3h - Workshop) Introducing core concepts such as *urban resilience, adaptive reuse*, and *sustainable urban regeneration*. The lecture covers global trends in urban retrofitting, highlighting its importance in achieving *energy efficiency* and *carbon reduction targets*. The workshop introduces *GIS-based* mapping techniques to identify underperforming building stock in Tirana, focusing on *climate-responsive* retrofitting opportunities and urban transformation. Topic 2. Historical and Theoretical Foundations of Building Retrofit. (2h - Lectures / 2h - Workshop)

	Historical evolution of building retrofitting, discussing *theoretical frameworks* such as *urban metabolism*, *post-modernist adaptation*, and *historic preservation*. The lecture emphasizes *circular economy principles* in retrofitting strategies and addresses *global best practices* with case studies. In the workshop, students analyze international retrofit examples with a focus on integrating *passive design strategies* and *socio-cultural continuity* Topic 3. Regulatory Frameworks and Urban Policy in the Balkans. (2h - Seminar / 2h - Workshop) This seminar provides an in-depth understanding of the *regulatory, economic, and socio-political* factors shaping retrofitting policies in the Western Balkans, with a particular focus on *Albanian urban policy*. *EU energy performance regulations*, *national retrofitting subsidies*, and *building code compliance*. The workshop focuses on assessing building stock based on *energy performance certifications (EPCs)* and evaluating the challenges of implementing policy-driven retrofitting in the local context. Topic 4. Material Technology in Building Retrofit. (2h - Lectures / 2h - Workshop) Innovations in *sustainable building materials*, including *phase-change materials (PCMs), bio-based insulation*, and *smart glazing*. The lecture emphasizes the importance of *life cycle assessment (LCA)* and *embodied carbon* in selecting materials for retrofit projects. In the workshop, students will use *DesignBuilder* software to simulate energy savings achieved through material upgrades, focusing on the *thermal performance* and *moisture management* of retrofit solutions. Topic 5. PU1 - Initial Project Ideas and feedback (2h – Pin-ups / 3h - Workshop) Students present their initial retrofit project concepts, incorporating principles of *design for adaptability* and *building energy modeling (BEM)*. Feedback focuses on optimizing the use of *parametric tools* such as *Grasshopper* for evaluating design options. In the workshop, students refine their retrofit strategies, integrating *bioclimatic design* and *renewable energy systems* to enhance overall project feasibility. Topic 6. Computational Design Methodologies in Retrofit – Part 1 (2h – Lectures / 3h - Workshop) Computational methods such as *parametric design*, *genetic algorithms*, and *performance-driven design* in the context of retrofitting. *Grasshopper* for *algorithmic design generation* and optimization, focusing on improving the *thermal and structural performance* of retrofit interventions. The workshop focuses on applying these methods to real-world building models, exploring *multi-objective optimization* techniques for balancing sustainability and aesthetics. Topic 7. Computational Design Methodologies in Retrofit – Part 2 (2h – Lectures/ 2h - Workshop) The lecture advances the previous computational design strategies and methods introduced in Part 1. Students will advance their *Grasshopper* and *algorithmic design skills* for optimization, focusing on improving the *thermal and structural performance* of retrofit interventions. The workshop focuses on applying these

methods to real-world building models, exploring *multi-objective optimization* techniques for balancing sustainability and aesthetics.

Topic 8. Structural Retrofitting Techniques.
(2h – Lectures/ 2h - Workshop)
Key structural retrofitting techniques, *seismic retrofitting*, *load-bearing enhancements*, and *foundation reinforcement*. The lecture emphasizes *structural health monitoring (SHM)* and *finite element analysis (FEA)* as tools for assessing structural integrity. In the workshop, students will explore the role of *resilient infrastructure* and *performance-based engineering* in ensuring that retrofitted buildings withstand seismic and environmental stresses.

Topic 9. Renewable Energy Integration in Retrofit Projects.
(2h – Lectures/ 2h - Workshop)
Integrating *on-site renewable energy systems* such as *photovoltaic panels (PV)*, *solar thermal systems*, and *wind turbines* into retrofitted buildings. The lecture highlights *net-zero energy retrofits* and *building-integrated photovoltaics (BIPV)*. In the workshop, students simulate the energy performance improvements from these renewable systems, focusing on optimizing *energy storage* and *grid interaction* for maximum efficiency.

Topic 10. Mid-Semester Design Critique
(2h – Pin-up/ 3h – Reviews & Feedback)
Students present their advanced retrofit design strategies. Feedback will focus on the integration of *passive solar design*, *green roof systems*, and *adaptive reuse principles*. In the workshop, students continue refining their projects, particularly improving *natural ventilation* and *daylight optimization* within their designs.

Topic 11. Indoor Environmental Quality and Retrofitting.
(2h – Lectures/ 2h - Workshop)
Improving *indoor environmental quality (IEQ)* in retrofitting projects, focusing on *indoor air quality (IAQ)*, *thermal comfort*, *natural daylighting*, and *acoustic performance*. The lecture discusses the importance of *ventilation systems*, *smart controls*, and *occupant well-being* in retrofit designs. In the workshop, students simulate the impact of their retrofit strategies on IEQ using computational tools.

Topic 12. Aesthetic and Heritage Considerations in Retrofitting
(2h – Lectures/ 2h - Workshop)
Aesthetic, cultural, and historical dimensions of building retrofits, particularly in *heritage conservation*. The topic covers *façade retrofitting*, *reversible interventions*, and *context-sensitive design*. In the workshop, students apply these principles to retrofitting historically significant buildings, balancing sustainability goals with *architectural preservation* and *urban identity*.

Topic 13. Sustainability Metrics and Retrofit Evaluation
(2h – Lectures/ 2h - Workshop)
Key Performance Indicators (KPIs) and *sustainability assessment frameworks* such as *BREEAM*, *LEED*, and *DGNB*. The lecture focuses on evaluating retrofit designs against *energy performance standards*, *carbon footprint*, and *life-cycle cost analysis (LCCA)*. In the workshop, students apply these metrics to evaluate the success of

	their retrofit projects, considering *energy payback periods* and *long-term environmental impacts*. Topic 14. Finalizing Retrofit Designs and Computational Models (3h – Workshop/ 1h - Review) Students refine their retrofit designs and computational models, applying advanced optimization strategies. The peer review session encourages students to give critical feedback on each other's projects, focusing on *resilience planning*, *sustainable material selection*, and *smart building technologies*. Topic 15. Final Presentation and Defense of Retrofit Projects (4h – Review & Presentations) Students present and defend their comprehensive retrofit designs to a panel of faculty and industry experts. The final deliverables include a detailed analysis of *energy savings*, *carbon emissions reductions*, and *long-term maintenance strategies*. The workshop will be used to refine the final submissions based on feedback from the presentation.
Methodology	**Learning Evaluation Methods**. The evaluation method is based on an overall evaluation of a project which is developed during the whole semester and, the evaluation of some specific aspects (skills, attendance, specific documents…) which are conducted at different points during the semester. The description of the methods is the following: 1- Project-Based Learning and Evaluation - Incremental Project Development: Students will undertake a semester-long retrofit design project that progresses in alignment with the course modules. This project will evolve from initial concept sketches and analyses to detailed designs and computational modeling, culminating in a comprehensive retrofit proposal. - Final Project Submission: The final deliverable will be a detailed retrofit design for a selected building in Tirana, incorporating computational design strategies and sustainable retrofit solutions. This comprehensive project will demonstrate the student's mastery over the subject's matter, including technical proficiency, problem-solving thinking capacities, as well as sustainable design principles. 2- Peer-to-Peer Learning and Evaluation - Peer Review Sessions: At various stages of the project development, students will engage in structured peer review sessions. - Collaborative Projects: In selected modules, students will work in teams on specific components of the retrofit project, such as energy modelling or material selection. This approach evaluates their ability to collaborate effectively, leveraging each member's strengths to achieve common goals. 3- Digital Portfolio and Reflection - Digital Portfolio Compilation: Students will compile a digital portfolio (on an online Miro Board) documenting their project development process, including research, design iterations, computational models, and final designs.

- Reflective Essays: Alongside the digital portfolio, students will submit 2 reflective essays discussing their design philosophy, the challenges they encountered, how they overcame them, and what they learned from the process.

4- Presentation and Defense
- Final Presentation: Students will present their retrofit projects to an evaluation panel consisting of faculty members and external experts. This presentation is an opportunity to showcase their project, articulate their design narrative, and demonstrate their command of computational design and retrofit strategies.
- Project Defense: Following the presentation, students will engage in a Q&A session, defending their design decisions and methodologies. This component evaluates their depth of understanding, ability to justify design choices, and responsiveness to critical feedback.

5- Presence during Hands-on Workshops and Bonuses
- Workshops: During the semester there are at least 2 hands-on workshops in way to advance the projects together with the mentors. The physical presence is crucial due to team-work and collaborative approach.

Bonus Points: During lectures there will be some logical/tricky questions as well as complementary deliverables along the semester. Students can profit to gain bonus points in order to be able to still achieve the full 100 points along the 5 modules.

Learning Evaluation Criteria.
The outcome of the evaluation is positive if the students prove to have knowledge of all the basic concepts covered in the course through minimal implementation in their projects.
The highest score is achieved by demonstrating in-depth knowledge of the course contents.
Praise is given to students through bonus points to fill possible gaps of absences; to those who are particularly brilliant in exposure and/or demonstrate mastery of the matters treated in the course or individual modules, being able to analyze topics not explicitly.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise

Points	**Evaluation**
94 - 100	10 - Excellent
83 - 93	9
75 - 82	8
65 - 74	7
55 - 64	6
50 - 54	5
0 - 49	4 – No Pass

Final Mark Allocation Criteria.
The final grade will be determined based on:
Project Development and Innovation: 30%
Collaboration and Peer Feedback: 20%
Digital Portfolio and Reflective Essays: 20%

	Final Presentation and Defense: 20% Presence in Semestral Hands-on Workshops: 10% This examination procedure is designed to mirror the real-world architectural design process closely, preparing students for professional challenges by emphasizing practical skills, critical thinking, collaboration, and continuous reflection and improvement.
Bibliography	- Urban Retrofitting for Sustainability - Mapping the Transition to 2050" by Dixon, T., Eames, M., Hunt, M., & Lannon, S., 2014 - "Urban Retrofit—Sustainable Behavior. From Building to Policy." Booklet by Gehl, Energy Foundation China & China Sustainable Transportation Center, 2019 - "Sustainable Retrofit & Facilities Management" by Paul Appleby, 2013 - "Assessing Sustainability and Organizational Innovation of Urban Regeneration Projects – Best Practices and Guidelines from the Apulia Region", by Ricciardelli A., Raimo N., 2022 - "Smart Materials" by Alex Ritter, 2006 - "The Grasshopper Primer" v 3.0 - "AAD Algorithmic-Aided Design – Parametric Strategies using Grasshopper" by Arturo Tedeschi, Le Penseur Publisher, 2014
Educational resources	1. Hydra Open-Source Scripts for Environmental Analyses https://hydrashare.github.io/hydra/ 2. Climate One Building https://climate.onebuilding.org/ 3. Design Builder Software (Advanced building performance simulation tool). Software purchased with the reZEB budget 4. Computers (Desktop computers able to run software for simulation). Equipment purchased with the reZEB budget 5. Geo-Thermal System purchased with the reZEB budget (Renewable energy technology to be connected to other systems already available in the Energy Efficiency Laboratory)

MODULE: ARCHITECTURAL TECHNOLOGY

Institution	Polis University
Module (Title)	**ARCHITECTURAL TECHNOLOGY**
Full Name of the Professor	Arben Shtylla
Hours:	Total Class Hours: 64 hours Lectures: 16 hours Studio Workshop: 48 hours
Program	- Integrated Master in Architecture and Urban Design - Second Academic year, First semester, October to February 2024-2025 - 6 ECTS - Mandatory
Learning outcomes	**Knowledge and understanding** - In-depth knowledge of architectural composition and technical solutions, which enable them to be realized in practice solutions. - In-depth knowledge of process analysis and deepening of the technical solutions by which the architect administers and controls all phases of the building construction process. - In-depth knowledge of controlling and evaluating the role that materials, products, and constructive systems have during the drafting of an architecture project, to fulfill the functional requirements and building usage. - In-depth knowledge of the relationships between users and spaces, on the one hand, and the functions of technical elements, on the other. - Critical awareness of innovative technical solutions for building envelope considering eco-friendly building materials. - Critical awareness of the interface between different fields of engineering, building physics and construction materials. - Comprehensive understanding of applicable techniques and methods of analysis, design, and their limitations. **Capacity to apply knowledge and understanding** <u>Architectural Analysis</u> - Ability to apply advanced traditional and innovative construction techniques. - Ability to design the architectural project up at the project level implementation. - Ability to develop the construction and constructive logic of the realization of the project. - Ability to conceptualize technics, processes, and systems. - Ability to identify, formulate, and solve complex problems in terms of architectural technology. <u>Architectural Design</u>

	- Ability for using the knowledge of technical elements and their qualities, as well as the criteria for the interaction of the constructive elements with each other, within a building to improve architectural designs. - Ability to design and develop new architectural details. Investigations - Ability to investigate the practical aspect, the technological and construction realization of the design and construction of architectural structures. - Ability to investigate the holistic perspective of a building as a singular assembly of construction structures. - Ability to dissect and examine the individual components that constitute this entirety. - Ability to investigate the application of new and emerging technologies at the forefront of their architectural specialization. Architectural Practice; - Ability to use analysis methods, control tools, problem-solving, and procedures essential for shaping the design and execution of construction projects. - Practical skills and the use of different tools from the laboratory for solving and understanding complex problems. - Ability to use Digital Modeling and Simulation via computer-aided design (CAD), software and building information modeling (BIM), tools to create virtual prototypes, simulate building performance, and to visualize design concepts. **Transversal skills** Making Judgements - Ability to integrate knowledge and handle complexity and to create a technological and architectural culture and design, according to which the DESIGNER is the director of all problems and specialties that are part of the building construction process, starting from the initial stage of design to the realization of the building in practice - Ability to formulate improved judgments after a critical review of the projects. Communication and Team-working - Ability to use different methods to communicate within the group. - Ability to work in groups and individually. - Ability to be involved, in continuous discussions and critiques with the professors and other specialists in the field. - Ability to lead a team of specialists for different proposals related to a specific topic. Lifelong Learning. - Ability to undertake simultaneously various aspects of other technical subjects and specialties like structures, technical installations, economic evaluation, etc., indispensable for an architect's preparation, - Ability to be engaged and consider the requisites and the intricate challenges inherent in the construction process following the latest developments on these issues. - Ability to be engaged in science development and emerging technologies.
Content	The goal of the "Architectural Technology" course is to cultivate the mindset of an architect within the student over the duration of the full curriculum. This involves

empowering students to design and execute comprehensive implementation projects.

Topic 1. Structure of Buildings
(2 h Lecture / 3 h Workshop; Consultation)
Vertical structures / horizontal and inclined structures/ Cladding structures/ Vertical cladding: vertical perimeter walls vertical external openings/ Horizontal or inclined cladding of the upper part: covers, insulating and thermal insulation layers, openings horizontal or inclined exterior/ Horizontal bottom cladding: ground floor slab, insulation and ventilation of underground parts, retaining walls/ Vertical interior partitions; internal walls, layers, internal vertical openings/ internal horizontal or inclined partitions: soles, stairs and their coverings
Foundations: Types include shallow (e.g., footings) and deep foundations (e.g., piles).
Load-Bearing Elements: beams, columns, and load-bearing walls
Floor Systems: Horizontal structures: slabs ,joists Wall Systems: Exterior walls for protection and insulation, and interior walls for dividing spaces.
Roof Systemstrusses or rafters.
Building Envelope: walls, windows, doors, and roofing. Role in insulation, weather resistance, and energy efficiency.

Workshop studio: Consultation, related to the first Powerpoint presentation. The students will be split into groups and will have to present a specific topic regarding a part of the structure of the building or its cladding.

Topic 2. Definition of technique and technology
(2 h Lecture / 3 h Workshop; Consultation)
Vitruvius' concept of architecture. The concept of technology in architecture. Technological design as a creation process. Construction as a process. Explanation of the interview with Renzo Piano.
Initial Conceptualization: Identifying the project requirements, goals, and constraints, including site conditions, budget, and client preferences.
Innovative materials, construction techniques, and technologies to inform design decisions and push the boundaries of architectural possibilities.
Introducing sustainable design principles for applying in architectural design, such as passive heating and cooling strategies, energy-efficient systems, and green building materials to minimize environmental impact and optimize energy performance.
Collaborative Design Processes (CDP) on how to engage with different stakeholders, including clients, engineers, contractors, and end-users, throughout the design process to ensure alignment with project objectives and address diverse needs and perspectives.
Introducing technological innovation through exploring cutting-edge technologies such as parametric design, digital fabrication, and augmented reality to push the boundaries of architectural expression and efficiency.

Workshop studio:Consultation, related to the first Powerpoint presentation. The students will be split into groups and will have to present a specific topic regarding a part of the structure of the building or its cladding.

Topic 3. Structure, technology, and construction techniques. Organization of the building. Building the foundations
(2 h Lecture / 3 h Workshop; Consultation)
Concepts of the building and its components. Types of foundations and their characteristics.
Some key components of buildings introduced are:
Foundation; Footings; Slab; Beams; Columns; Load-bearing walls; Floor systems; Roof systems; Trusses; Rafters; Building envelope; Exterior walls; Interior walls; Windows; Doors; Staircases; Elevators; HVAC systems; Plumbing systems; Electrical systems; Insulation; Cladding; Facade; Basement; Attic; Ceilings; Balconies; Terraces; Fire safety systems; Acoustic treatments; Structural framing; Ventilation systems; Waterproofing.

Workshop studio: Final presentation of the first task.

Topic 4. Masonry
(2 h Lecture / 3 h Workshop; Consultation)
Characteristics of masonry constructions. Masonry in history. Masonry in our day. Masonry component materials. Its functional elements. Typology. Requirements for their design. Classification of ceramic elements. The effect of the earthquake on these structures. Sound resistance. Intercap. Thermal resistance.
Brick masonry; Stone masonry; Concrete block masonry; Glass block masonry; Reinforced masonry; Unreinforced masonry; Solid masonry; Hollow masonry; Dry stack masonry; Veneer masonry; Structural masonry; Cladding masonry; Load-bearing masonry; Non-load-bearing masonry; Ashlar masonry; Rubble masonry; Coursed masonry; Uncoursed masonry; Composite masonry.

Workshop studio: Investigation and introduction of specific instruments such as Testo Thermal Cameras; Testo U-value measurements; Hygrometer, and AR glasses. The students will be able to gain in-depth knowledge of the thermal performance of different materials and facades, as well as the allowed moisture level in the indoor area.

Topic 5. Supporting structures at height, summary. Slabs
(2 h Lecture / 3 h Workshop; Consultation)
The role of structure. The burdens it bears. Structure in the history of architecture. Structure in modern times. Structural elements. Constructive system with masonry. Design criteria. Structural framework system. Classification of constructive building systems. Slabs. The typology of slabs. Slabs with beams. Slabs with metal structure. Mixed slabs.
Flat slab; One-way slab; Two-way slab; Hollow-core slab; Ribbed slab; Waffle slab; Post-tensioned slab; Precast concrete slab; Composite slab; Steel deck slab; Bubble deck slab; Suspended slab; Ground-bearing slab; Continuous slab; Cantilever slab; Slab-on-grade.

Workshop studio: Investigation and introduction of specific instruments such as Testo Thermal Cameras; Testo U-value measurements; Hygrometer, and AR glasses. The students will be able to gain in-depth knowledge of the thermal performance of different materials and facades, as well as the allowed moisture level in the indoor area.

Topic 6. Presentation of the second task
(4 h Workshop; Presantation)
Students present their topics and their findings. In the end, they receive comments from the professors.

Topic 7. Renzo Piano's
(3 h Workshop; Disscusions)
The students attend a presentation delivered by Renzo Piano, one of his recent talks, discussing his journey as an architect and showcasing his notable projects.
Sustainability; Lightness; Transparency; Natural light; Integration with the environment; High-tech architecture; Human scale; Urban context; Flexibility; Modularity; Minimalism; Innovative materials; Prefabrication; Energy efficiency; Passive design; Exposed structural elements; Precision engineering; Seamless connections; Natural ventilation; Acoustic performance; Tensile structures; Dynamic facades; Green roofs; Sun shading systems; Detailing in joints and interfaces; Custom-designed components; Integration of art and architecture; Attention to user experience; Craftsmanship; Adaptive reuse.

Workshop studio: Each student will be assigned a specific topic within the realm of architectural technology, and they will be responsible for detailed planning up to the implementation phase of the project.

Topic 8. Covers. Library in Curno
(2 h Lecture / 3 h Workshop; Consultation)
Historical overview. Defining the concept of covers. Qualities of covers. Types of covers. How is their classification done? Functions of covers. The solutions of their unions with other elements. The form of covers in buildings with large spaces. Environmental impact. Library in Curno.
Vegetated roofs; Green roofing systems; Intensive green roof; Extensive green roof; Substrate depth; Waterproofing membrane; Root barrier; Drainage layer; Irrigation systems; Native plants; Drought-resistant vegetation; Thermal insulation; Biodiversity enhancement; Stormwater management; Urban heat island mitigation; Lightweight soil mixtures; Permeable paving; Planter boxes; Structural load capacity; Maintenance access; Safety railings; Wind protection; Rainwater harvesting; Solar integration; Sustainable landscaping

Workshop Studio: Consultation. Task nr.3

Topic 9. Site visits
(4 h Wokshop; Site visit)
Planned study visits to significant construction sites will feature detailed presentations by their technical managers, outlining the entire construction procedure and technologies employed. Simultaneously, students are expected to incorporate reflections and recommendations on the realization of structures and designed elements into their assignments.

Topic 10. Clothing/vertical partitions in buildings
(2 h Lecture / 3 h Workshop; Consultation)

	Definition, function, technical requirements. A historical look at the building envelope as a supporting structure. The concept of building an envelope with a supporting structure. Cladding with brick walls. Ventilated facade. Double-skin facade. Building envelope in today's constructions. Isolation with "hood". Ventilated facade. Thermal performance of double skin facade. Thermal insulation; Heat transfer reduction; Natural ventilation; Solar gain control; Shading devices; Air cavity; Ventilated air gap; Thermal buffering; Convection currents; Glazing types; Low-emissivity glass; U-value; Thermal bridging; Seasonal performance; Energy efficiency; Heat recovery; Dynamic facade; Internal and external skin; Climate-responsive design; Automated shading; Passive solar heating; Cooling load reduction; Daylighting. *Workshop Studio: Consultation. Task nr.3. Axonometric explosion of the façade systems design and 3d models will be integrated* Topic 11. Building and project cost calculation (2 h Lecture / 3 h Workshop; Consultation) Project solution. Project evaluation. Methodology. Calculation of the cost of elements. Classification of construction works. Cost structure of construction works. Technical analysis. Estimate of works. Project cost. Calculation of the approximate estimate. Life cycle costing; Initial investment; Operational costs; Maintenance costs; Energy costs; Replacement costs; Disposal costs; Total cost of ownership; Cost-benefit analysis; Economic evaluation; Sustainable investment; Long-term savings; Return on investment (ROI); Payback period; Net present value (NPV); Capital expenditure (CapEx); Operating expenditure (OpEx); Lifecycle analysis; Residual value; Energy efficiency; Green building certification; Durability; Material lifespan; Environmental impact; Cost-effectiveness; Performance metrics; Life cycle assessment (LCA). *Workshop Studio: Consultation. Task nr.3. Axonometric explosion of the façade systems design and 3d models will be integrated* Topic 12. Summary of lectures (3h Workshop; Disscusions) A summary of the lectures is provided, highlighting key areas for exam focus. Discussions ensue regarding the semester-end project, which students will submit upon completion. *Workshop Studio: Consultation. Task nr.3. Axonometric explosion of the façade systems design and 3d models will be integrated.* Topic 13. Site visits (4h Workshop; Site visit) Planned study visits to significant construction sites will feature detailed presentations by their technical managers, outlining the entire construction procedure and technologies employed. Simultaneously, they will get recommendations from experts on the realization of structures and designed elements into their assignments.

	Topic 14. Project consultation (3h Workshop; Consultation) This week is to give students an opportunity to wrap up their second-course assignment projects and get final feedback from professors. *Workshop Studio: Consultation. Task nr.3. Axonometric explosion of the façade systems design and 3d models will be integrated.* Topic 15. Project delivery (3h Workshop;Consultation) The student submits the project of the second assignment and receives comments from the professors.
Methodology	**Learning Evaluation Methods**. Attendance and participation during lectures and seminars, a written exam and three assignments/tasks. The tasks consist of: FIRST TASK: The topics of the assignment include all the main elements of the building: literature review, site visits, and technical drawings. The presentation of the task will be done with a presentation, as well as it will be submitted in the form of a technical report, with text, drawings, photographs, etc., as well as the literature used will be reflected. SECOND TASK: Students will develop a specific building structure, bearing structure, and cladding structure. The chosen topic will be linked to a wider and more detailed research both in the literature and in the practice of design and implementation. The topics of the assignment will be chosen from the following chapters: - Foundation structures; - Residential buildings with different structures; - Building with large spaces; - Cladding structure, vertical cladding; - Cladding structure, horizontal cladding. - The theoretical lectures will be combined with the seminars so that the knowledge gained during the lectures will be reinforced, checked, and realized in practice. During the seminars, exercises will be developed which are intended to be solved in cooperation between students and teachers. - For both tasks, two intermediate submissions are provided, which will be graded. THIRD TASK: Students will create an axonometric explosion of their façade systems design integrating 3D models to illustrate how elements come together in a cohesive architectural solution. Finally, they will made a presentation. **Learning Evaluation Criteria**. The aspects to be evaluated and the criteria for their evaluation are:

- Design Proficiency: Assessment of the creativity, functionality, and aesthetics of the architectural designs produced by students.
- Technical Skills: Evaluation of students' ability to use software tools and technologies relevant to architectural design and documentation.
- Understanding of Building Systems: Assessment of knowledge regarding structural, mechanical, and electrical systems and their integration into architectural solutions.
- Project Presentation: Evaluation of clarity and effectiveness in presenting design concepts, including the use of visual aids and oral communication skills.
- Problem-Solving Ability: Measurement of how well students identify and address design challenges through innovative and practical solutions.
- Sustainability Considerations: Assessment of how effectively students incorporate sustainable practices and materials into their designs.
- Collaboration and Teamwork: Evaluation of students' ability to work effectively in groups, demonstrating communication and cooperation throughout the project.

Additionally, the final exam will assess their knowledge related to the lectures and workshop studio activities.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise.

Points	Grades
94-100	10
83-93	9
75-82	8
65-74	7
55-64	6
50-54	5
0-49	4

Final Mark Allocation Criteria.
- Participation weight 10% (mandatory)
- First task control weight 25%
- Second and third tasks control weight 35%
- Written exam weight 30%

Bibliography

Required:
- Esmond Reid, Understanding Bulidings: A multidisciplinary approach, The MIT Press, London, 1984.
- Esmond Reid. Idem. Translated in Albanian. (website Polis University)

Recommended:
- M. Torricelli, R. del Nord, F. Paolo, Materiali e tecnologie dell'architettura, Laterza, 2007
- Lessons summary Progetto e Tecnologia. (Polis University library)
- Architettura-Zevi - Il Nuovissimo Manuale Dell Architetto_con indice e link.pdf. (website Polis University)
- http://www.archinfo.it
- http://www.edilportale.com

	- Revista MODULO, Progetto e Tecnologia. (Biblioteka Polis University) - Revista Detail - Architettura-Zevi - Il Nuovissimo Manuale Dell Architetto_con indice e link.pdf. (website Polis University) - Esmond Reid, Understanding Buildings: A multidisciplinary approach, The MIT Press, London, 1984. - Esmond Reid. Idem. Translated in Albanian. (website Polis University). - Revista MODULO, Progetto e Tecnologia. (Polis University Library) - Revista Detail - Architettura-Zevi - Il Nuovissimo Manuale Dell Architetto_con indice e link.pdf. (website Polis University)
Educational resources	1. Hygrometer (Tool to measure the moisture level of the materials and water infiltration in building envelope layers). Equipment purchased with the reZEB budget 2. Thermal Camera (Testo) (in-house) 3. Testo U-value instrument (in-house) 4. AR glasses (augmented reality glasses) (in-house)

Institution	Polis University
Module (Title)	**ENVIRONMENTAL DESIGN STUDIO**
Full Name of the Professor	Klodjan Xhexhi
Hours:	Total class hours: 60 hours Lectures: 36 hours Studio Workshop: 24 hours
Program	- Integrated Master in Architecture and Urban Design - Third Academic year, First semester, October to February 2024-2025 - 6 ECTS - Mandatory
Learning outcomes	**Knowledge and understanding** - In-depth knowledge of the principles to solve bioclimatic problems in order to minimize energy consumption to zero. - Comprehensive understanding of the concepts: "Passive house" or "ZEB" (Zero Emission Building). - In-depth knowledge to understand the other program outcomes related to building design independent of the electrical grid. - In-depth knowledge of the tools to create sensitivity toward recycling issues, optimal thermal comfort, and minimizing heating and cooling loads through passive systems or thermal insulation. - In-depth knowledge of the tools to create sensitivity toward the climatic conditioned of the specific country and how to make use of these parameters from the initial stage of design. - In-depth knowledge of the wider multidisciplinary context of engineering and of the issues at the interface between different fields such as Architectural Studios, and Building Physics. **Capacity of applying Knowledge and Understanding** <u>Architectural Analysis</u> - Ability to conceptualize and solve different tasks related to bioclimatic design and passive systems. - Ability to analyze materials of construction and thermal insulation. - Ability to analyze recycling strategies and smart materials. - Ability to select the most relevant option using passive design strategies. - Ability to identify, formulate and solve different problems, regarding the renewable energy technologies such as geothermal systems, PV panels, and wind turbines. - Ability to identify the right orientation of buildings using Desing Builder Software. <u>Architectural Design</u> - Ability to develop an Architectural design according the principles of bioclimatic architecture for the Albanian case.

- Ability to develop new design strategies based on passive solar systems.
- Ability to design and develop solutions using Design Builder Software.
- Ability to calculate PV panels needed based on the consumption, using Retscreen software.
- Ability to understand, measure, and develop new strategies about the important role of moisture content in building materials, and its role in human health.

Investigations

- Ability to investigate the roots of Bioclimatic design and critically get used to it.
- Ability to investigate urban analysis, climatological conditions, thermal comfort charts, SWOT analyses, vegetation, potential scenarios, solar radiation, shading, ventilation and cooling systems, and thermal traps during the cold season.
- Ability to identify locate and obtain required data using Design Builder Software, Retscreen, PV panels, and Wind turbine.
- Ability to conduct experimental investigation using a Hygrometer, PV panels kit Wind turbine, and computers.

Architectural Practice

- Comprehensive understanding and advanced knowledge of bioclimatic design with high environmental sensitivity, for its application in the construction of high-energy efficiency buildings with zero energy consumption.
- Ability to understand and combine theoretical plans (block of lectures) with students' presentations and practical plans (project design).
- Ability to proficiently use materials, passive strategies, equipment, and tools, being aware of their limitation.
- Ability to apply norms using Design Builder Software, Retsceen, geothermal systems, PV panels, wind turbines, and computers.

Transversal skills

Making Judgements

- Ability to make judgments related to passive design strategies and bioclimatic design.
- Ability to enable critical thinking regarding the projects in order to improve their own judgments.
- Ability to formulate judgments using Design Builder Software, Retsceen, geothermal systems, PV panels, and wind turbines.

Communication and Team-working

- Ability to work in groups
- Ability to get involved with continues discussions and critiques with the professors and other specialist in the field.
- Ability to lead a team of specialists for different proposals related to a specific topic.

Lifelong Learning.

- Ability to be engaged in a deeper perception of bioclimatic architecture by following the development of this discipline.
- Ability to be engaged in independent life-long learning of green, solar, passive, sustainable, bioclimatic, and environmental designs.
- Ability to recognize the need of keeping up to date with the use of Design Builder Software, Retsceen, geothermal system, PV panels, wind turbines, and Hygrometers for independent purposes and autonomous studies.

Content	Topic 1. Introduction to environmental design. Bioclimatic architecture. Climate and its factors. (4 h Lecture) Difference between sustainable and green design. Historical perspective of bioclimatic architecture. Case studies. Hypocausti, Ondoli, hydraulics. Bioclimatic architecture and philosophy. Greek cities and bioclimatic architecture. What is bioclimatic architecture? Vulnerability of the existing energy supply network. Energy security and its dilemmas. Climatological changes. Global temperature. CO2 emissions. Global greenhouse effect emissions and warming scenarios. The European objective (net zero in 2050). The EU Green Agreement. Energy efficiency. Renewable resources in Albania and the region. Sustainable policies of the Municipality of Tirana.. Thermal comfort chart. Zero energy building (ZEB). Climate of Albania. . Urban Heat Islands. The CO2 emissions, temperature, and relative humidity in urban and suburban areas. The allowed norms and actual values in the city of Tirana. Climate parameters of Albania. The concept of Albedo effect and its role in the inner city. Urbanization; Heat absorption; Temperature differential; Concrete and asphalt; Thermal mass; Heat retention; Lack of vegetation; Solar radiation; Infrared radiation; Anthropogenic heat; Microclimate; Reflective surfaces; Cool roofs; Green roofs; Vegetation cover; Tree canopy; Shading; Evapotranspiration; Climate change; Energy consumption; Air quality; Public health; Urban planning; Mitigation strategies; Sustainable design; Permeable pavements; Heat mitigation; Cooling centers; Temperature regulation. *-Assignment: The students are required to make a short 3-minute video on the environmental problems of the city of Tirana (research in groups). (Presentation of the design task).* Topic 2. Urban ecosystem. Energy design. Thermal insulation. (4 h Lecture / 1h Workshop; Consultation) Pollution in urban space. Acoustic, atmospheric, urban, and aesthetic pollution. Green surfaces and their role in the ecosystem. Greenery and vegetation. Case studies. Energy design, minimization of thermal losses, and utilization of climatic conditions (climate, microclimate, solar radiation). Factors that affect thermal mass, external surface/volume ratio, orientation, placement against the direction of predominant winds (wind trend study), and thermal insulation. Use of PCM materials. Green building standards; LEED certification; Net-zero energy; Energy audit; Renewable energy integration; Low-emissivity coatings; Thermal mass; Building automation systems (BAS); Occupancy sensors; Energy performance monitoring; Demand response; Lifecycle energy analysis; Sustainable materials. *-Video consultation* *-Assignment: Informative sketches.* Topic 3. Passive systems. Disconnected systems. Systems with indirect benefit. (4 h Lecture / 2h Workshop; Presentation) Massive wall. Dimensioning of the openings in the facade. WWR (window/masonry ratio) and WFR (window/floor ratio) ratios. International standards and norms. Case

studies. Trombe wall, operation, components, winter/summer, night/day scenarios. Case studies. Water wall, Barra Costantini, their operation, components, winter/summer, night/day scenarios. Roof pond, its operation, components, winter/summer, and night/day scenarios. Detached systems, thermosiphon, greenhouses. Thermosiphon, operation, components, winter/summer, night/day scenarios. Greenhouse, operation of the greenhouse, components, winter/summer, night/day scenarios. Case studies. Solar chimney, operation, components, winter/summer, night/day scenarios. Wind towers. Case studies. The use of solar energy directly, indirectly, and through disconnected systems. Greenhouse effect. The main elements of passive solar systems. The role of shaders and the inclination of the facade. Glass quality. Active systems.

Laboratory work + studio workshop
Introduction of the Design-Builder Software, or Retscreen software. Their role in Energy efficiency of buildings.
Design Builder will be explored in terms of 3d modeling, visualization, simulation, daylighting, optimization, and costs.
Retsceen will be utilized as a calculation tool to optimize the usage of PV panels.

-Presentation of videos. Presentation of the topic: Library design (about 500m2) Informative sketches.

Topic 4. Thermal comfort. Photovoltaic systems. Natural ventilation. Recycling. Renewable energy.
(4 h Lecture / 2h Workshop; Laboratory work)
Thermal comfort and its components. Temperature, air movement, humidity, type of clothing, metabolism, and radiant temperature. Photovoltaic systems, solar panels, and their operation. Natural ventilation. Case studies. Submerged or semi-submerged buildings. Cooling and heating strategies. Canadian well. Ventilation schemes in plan and section (cross and stack ventilation). Air movement as a result of temperature and pressure differences. Water recycling in the building. Recycling of black, white, and gray water. Dimensioning of main systems. Dimensioning of the thermal mass, dimensioning of the greenhouse as well as the roof pond. Their optimization is according to the climate in Tirana. Optimal thermal wall thickness. Piezo-electric materials and the piezoelectric effect. Energy independence of buildings from the electricity supply network.
Solar panels; Photovoltaic cells; Solar energy; Renewable energy; Solar power; Solar modules; PV arrays; Silicon cells; Thin-film technology; Solar electricity; Solar radiation; Solar conversion; Energy generation; Solar efficiency; Solar irradiance; Solar tracking; Solar installation; Grid-tied systems; Off-grid systems; Net metering; Feed-in tariffs; Solar incentives; Solar financing; Solar rebates; Solar integration; Solar technology; Solar innovation; Solar industry.

Laboratory work + studio workshop
Introduction of the instruments Blower door, Wind turbine, Solar panels, hydrometer, geothermal system. Their role in Energy efficiency of buildings.
Blower door will be used in the lab in order to detect air infiltration within the room at a given air pressure.
The wind turbine will be connected to the lab and checked for its energy supply.
PV panels will be checked for their energy supply in the lab.

-Presentation of informative sketches
Task: Site analysis. SWOT analysis + program.

Topic 5. Villa design – Part 1 - (about 250 m^2) (Site of construction: Tirana)
(4h Lecture/ 1 h Workshop; Consultation)
-Project presentation

Environmental analysis, summer and winter solstice, solar radiation schemes of the site, and urban and building scale analysis.
-Consultations. Group organisation

Topic 6. Villa design – Part 2A - (about 250 m^2) (Site of construction: Tirana)
(2h Lecture/ 2 h Workshop; Consultation)
-Concept + zoning

Topic 7. Villa design – Part 2B - (about 250 m^2) (Site of construction: Tirana)
(2h Lecture/ 2 h Workshop; Consultation)
-Concept + zoning

Topic 8. Villa design – Part 3 - (about 250 m^2) (Site of construction: Tirana)
(2h Lecture/ 2 h Workshop; Consultation)
Functional solution + potential, winter-summer scenarios; day-night, north-south section. Proposal for the implementation of passive solar systems.
The concept of geothermal energy using the Geo-Thermal System. The role of Hygrometer in the quality of the indoor environments. The role of the blower door as an air pressure and infiltration calculator.

Topic 9. Pin-up No.1
(1h Workshop; Presentations)
-Pin-up. No. 1, Presentation

Topic 10. Villa design – Part 4 - (about 250 m^2)
(2h Lecture/ 2 h Workshop; Consultation)
-Potential scenarios together with passive systems, plan, section, facade, 3d. Details. Thermal insulation.
The concept of geothermal energy using the Geo-Thermal System. The role of Hygrometer in the quality of the indoor environments. The role of the blower door as an air pressure and infiltration calculator.

Topic 11. Villa design – Part 5A - (about 250 m^2)
(2h Lecture/ 2 h Workshop; Consultation)
-Potential scenarios of passive solar systems, plan, section, facade, 3d. Details. Thermal insulation. Scale model 1:250
Retscreen calculation regarding the PV panels needed. Solar PV panels Kit. Calculation of the energy produced by the Wind Turbine.

Topic 12. Villa design – Part 5B - (about 250 m^2)
(2h Lecture/ 2 h Workshop; Consultation)
-Potential scenarios of passive solar systems, plan, section, facade, 3d. Details. Thermal insulation. Scale model 1:250

	Rescreen calculation regarding the PV panels needed. Solar PV panels Kit. Calculation of the energy produced by the Wind Turbine. Topic 13. Villa design – Part 5C - (about 250 m^2) (2h Lecture/ 2 h Workshop; Consultation) -Potential scenarios of passive solar systems, plan, section, facade, 3d. Details. Thermal insulation. Scale model 1:250. Desing Builder Software calculation of external exposure of the building and its orientation. Topic 14. Pin-up No.2 (1 h Workshop; Presentations) -Pin-up. No. 2, Presentation Topic 15. Villa design – Finals - (about 250 m^2) (2h Lecture/ 2 h Workshop; Consultation) Design Bulder Software calculation of external exposure of the building and its orientation. -Final overall consultations.
Methodology	**Learning Evaluation Methods**. Evaluation of the active participation of students, evaluation of some specific works (videos, case studies…) and checks (two intermediate and the final) of the project delivered through the semester. Description: 1. Presentation of videos (group work) The students will be guided to make a 3-minute video about the environmental issues in the city of Tirana. 2. Presentation of case studies as well as technical files of passive systems (group work). The students will be asked to study one of the passive systems and to investigate three case studies of their application. 3. First check Urban and environmental analysis of the site, climatological data, thermal comfort chart, infrastructure, shading/sunlight according to solstices and equinoxes, analysis of existing building materials, architectural language of the area, photos, and graphic processing. Design builder calculation of the external exposure of a building, considering its orientation. 4. Second check Concept, urban analysis, site analysis, potential operating scenarios of the selected passive system (winter/summer, night/day). Ventilation schemes and cooling strategies. Plan, section (north/south), conceptual 3d, facade, details. 5. Final delivery Urban analysis, site analysis, and potential operating scenarios of the selected passive system (winter/summer, night/day). Ventilation schemes and cooling strategies. Plan, section (north/south), 3d, facade, details up to project implementation. Scale model 1:250 Calculation of PV panels needed using Retscreen.

Learning Evaluation Criteria.

The learning evaluation criteria encompass several key areas: the quality of presentations, which assess clarity and engagement; the use of technical vocabulary, ensuring effective communication of complex concepts; the correct application of graphic scales for precision in visual representations; and the completeness of tasks to gauge thoroughness. Additionally, students will be evaluated on their technical projects, specifically the correct use and implementation of passive systems to maximize building energy efficiency.

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Points	Grades
94-100	10
83-93	9
75-82	8
65-74	7
55-64	6
50-54	5
0-49	4

Final Mark Allocation Criteria.

- Participation weight 10% (mandatory)
- Presentation of videos weight 10%
- Presentation of case studies weight 10%
- First control weight 20%
- Second control weight 20%
- Final project + weight 30%

Bibliography

Required:

- "Lezioni di architecttura bioclimatica" Alessandro Gioli; ISBN: 88-8125-281-3 (Book)
- "The Passive Solar Energy Book" Edward Mazria (Book)
- "Ecocities and Ecovillages. Bioclimatic applications from Tirana, Albania" Klodjan Xhexhi (Book)
- "The impact of building materials in inhabitance lifestyle" (2021) Klodjan Xhexhi; Publishing house: Generis publishing (Book) ISBN-13: 978-1639028627
- "Bioclimatic housing. Innovative Design for Warm Climates" Richard Hyde; ISBN: 978-1-84407-284-2 (Book

Recommended:

- "Design with Climate. Bioclimatic Approach to Architectural Regionalism" Victor Olgyay; (Book)
- "Bioclimatic Architecture in Warm Climates. A guide for best practices in Africa" Manuel Correia Guedes ISBN 978-3-030-12035-1 (Book)
- "Bioclimatic Architecture" John R. Goulding and J. Owen Lewis (Book)
- "Materials and design. The art and science of material selection in product design" Mike Ashby and Kara Johnson" ISBN 0-7506-5554-2 (Book)

Educational resources	All the highlighted equipment has been purchased with the reZEB budget. 1. Blower door (Tool to measure the tightness level of a closed space in order to detect air infiltration and improve energy efficiency of buildings); 2. Wind Turbine 2kW (Renewable energy technology to be connected to other systems already available in the Energy Efficiency Laboratory) 3. Solar PV panels (4kWp solar PV system to be connected to other systems already available in the Energy Efficiency Laboratory) 4. Solar PV system (Demonstrative kit for didactic purposes) 5. Hygrometer (Tool to measure the moisture level of the materials and water infiltration in building envelope layers) 6. Design Builder Software (Advanced building performance simulation tool). 7. 2 Computers (Desktop computers able to run software for simulation) 8. Geo-Thermal System (Renewable energy technology to be connected to other systems already available in the Energy Efficiency Laboratory) 9. Retscreen software for the calculation of PV panels is needed.

Institution	Polis University
Module (Title)	**TECHNICAL PHYSICS AND PLANT ENGINEERING**
Full Name of the Professor	Dashamir Çutra
Hours:	Credits: 6 ECTS Total Class Hours: 72 hours Lectures: 36 hours Seminars/ Workshop: 36 hours
Program	- Integrated Master in Architecture and Urban Design - Third Academic year, First semester, October to February 2024-2025 - 6 ECTS - Mandatory
Learning outcomes	**Knowledge and understanding** - In-depth knowledge of the physical parameters of active building systems that characterize the internal inhabited environments as well as the determination of the ways, tools, and systems for their provision and preservation. - In-depth knowledge of indoor environment quality, encompassing thermal comfort, air quality, visual comfort, and acoustic comfort. - In-depth knowledge of technical physics laws and parameters of the aforementioned issues. - Critical awareness of the tools and integral energy systems to maintaining the above-mentioned parameters within residential spaces. - In depth knowledge of natural and mechanical ventilation systems, cooling systems including heat pumps, lighting setups, and acoustic systems. - Critical awareness of the prudent utilization of the aforementioned systems, emphasizing energy efficiency—a pivotal consideration in everyday construction scenarios. - In-depth knowledge to comprehend the operation and interrelation of active building component systems, ultimately aimed at ensuring human comfort. - Critical awareness of the integration of above-mentioned systems into the design of various structures, ensuring their proper implementation. **Capacity of applying Knowledge and Understanding** <u>Engineering Analysis</u> - Ability to conceptualize the challenges related to indoor environment quality, closely linked to energy efficiency, aiming economical operation of building systems. - Creative skills-to identify, formulate, or solve unfamiliar complex engineering problems using different methodologies. - Ability to analyze using various devices or systems for monitoring indoor environment quality parameters, such as thermal cameras, laser thermometers, moisture meters, blower doors, or geothermal systems. - Ability to be involved in encountering complex problems that require innovative solutions.

- Ability to analyze problems, think critically, and propose creative approaches to overcome challenges

Engineering Design

- Ability to adopt, create, and understand the new and original design methodologies using the aforementioned instruments.
- Ability to apply the appropriate and relevant design methodology.
- Ability to comprehend the functionality and interplay of building component systems, for ultimately geared towards enhancing human comfort.
- Ability to incorporate these systems into the design of diverse structures with precision and efficacy.

Investigations

- Ability to investigate, identify, locate, and obtain data from the laboratory practice.
- Ability to conduct experimental investigations, critically evaluate, and draw conclusions using the tools provided.

Engineering Practice

- Ability to use in architectural practice the basic understandings of stability, functionality, and aesthetics of a building; how to ensure and maintain the quality of internal environments, as well as the energy performance of the buildings.
- Compressive understanding of equipment's and tools, engineering technologies, processes, their limitations, and awareness of economic and managerial issues.

Transversal Skills

Critical Analysis

- Ability to handle complexity and formulate judgments with limited information.
- Ability to manage intricate technical or professional tasks or projects that may necessitate innovative strategic approaches, while assuming accountability for decision-making processes.

Communication and team working

- Ability to effectively conveying thoughts, actively listening to others, and expressing themselves with clarity, whether orally or in written form.
- Ability to explain technical concepts in a manner accessible to all audience.
- Ability to collaborate within the group for problem-solving tasks in order to strengthen their expertise.
- Ability to collaborate with each team member who brings unique technical knowledge and skills to the table.
- Ability to contribute to the overall success of the team.
- Ability to communicate with peers.
- Ability to share responsibilities, coordinate tasks, and work towards common goals.
- Ability to be able to contribute their expertise while also being open to others' perspectives and feedback.

Lifelong Learning

	- Ability to be engaged in a rapidly changing technical landscape, contribute meaningfully to their professions and continue growing throughout their careers. - Ability to get involved and stay updated with advancements in technical physics and engineering principles. - Ability to master new software tools, and newly implemented systems, learn about emerging technologies, or hone problem-solving abilities.
Content	Topic 1: Basic and fundamental concepts of technical physics. Energy, power, and energy sources. (2 h Lecture) Introduction to the basics of technical physics: Transmission and distribution of energy systems. What is energy? What is Power and their equations? Voltage, resistance, current and grid distribution. AC and DC current flow in a circuit. Electrical grid; Power lines; Transmission lines; Distribution lines; Transformers; Substations; Voltage; Current; Alternating current (AC); Direct current (DC); Grid infrastructure; Grid reliability; Grid resilience; Grid modernization; Smart grid; Microgrids; Power generation; Load balancing; Energy loss; Voltage regulation; Frequency regulation; Grid stability; Energy management; Grid maintenance; Grid expansion; Grid optimization; Grid planning. Topic 2. Methods of heat transfer: Conduction, Convection, and Radiation. (2 h Lecture / 2 h Workshop; Laboratory) Concept of heat and the ways of its transfer accompanied by practical examples: U (value) coefficient. How it is calculated. What is thermal resistance? What is thermal transmittance? Rse, Rsi, and layers in a wall section. U-value; R-value; Thermal conductivity; Heat transfer coefficient; Insulation value; Building envelope; Thermal resistance; Thermal transmittance; Heat flow; Building materials; Energy efficiency; Thermal conductivity of materials; Fourier's Law; Temperature difference; Units (W/m^2K or $Btu/h \cdot ft^2 \cdot °F$) *Seminar:* *Lab: U (value) calculation using Testo instrument.* Topic 3. Energy performance in buildings, the building shell, its components, and functions. (2 h Lecture / 2 h Workshop; Laboratory) The building as a thermodynamic object or system, shell and energy system: HVAC (Heating, Ventilation, and Air Conditioning); Mechanical ventilation; Air conditioning; Heating systems; Cooling systems; Artificial lighting; Electric fans; Heat pumps; Boilers; Chillers; Pumps; Ductwork; Thermostats; Building automation systems; Energy management systems; Energy consumption; Energy efficiency; Energy demand; Electrical load; Utility bills; Operational costs; Environmental impact; Carbon footprint; Renewable energy integration; Energy conservation measures Topic 4. Control of heat exchanges between the external and internal environment, ways to improve the energy performance of the building shell.

(2 h Lecture / 2 h Workshop; Laboratory)
Classification of thermal loads into external and internal:
Building components and layers of a wall. Thermal insulation .
Insulation materials; Thermal conductivity; Thermal resistance; R-value; U-value; Insulation effectiveness; Insulation thickness; Insulation types (e.g., fiberglass, foam, cellulose); Reflective insulation; Radiant barriers; Vapor barriers; Air barriers; Thermal bridging; Insulation installation; Insulation properties; Thermal performance; Building codes; Energy conservation; Sustainable construction; Green building.

Seminar:
Lab: Temperature of the façade using Testo Thermal camera.

Topic 5. Improving the thermal performance of opaque and transparent surfaces.
(2 h Lecture / 2 h Workshop; Laboratory)
Heat exchange, thermal performance on different surfaces:
Solar radiation and albedo; Snow; Ice; Clouds; Vegetation; Urban surfaces; Dark surfaces; Light-colored surfaces; Heat absorption; Global warming; Climate change; Energy balance; Climate modeling
Environmental impact; Radiative forcing; Urban heat island; Melting ice caps; Sea level rise; Climate mitigation; Climate adaptation; Sustainable design; Green building; Cool roofs; Cool pavements; Urban planning
Opaque Surfaces: Insulation Materials, Reflective Coating, Thermal Mass, Air Sealing, Green Roofs/Walls
Transparent Surfaces: Low-E Glass, Window Film, Multi-Layered Glazing, Shading Devices, Ventilated Facades

Topic 6. Quality of indoor environments and ventilation, strategies for its improvement.
(2 h Lecture / 2 h Workshop; Laboratory)
Indoor Air Quality (IAQ):
Indoor pollutants; Cooking emissions; Cleaning products; Smoking; Carbon dioxide (CO2); Volatile; organic compounds (VOCs); Particulate matter; Dust; Allergens; Ventilation rates; Building codes; Impact on Energy efficiency; Comfort; Health; Productivity; Indoor Environment Quality (IEQ).

Seminar:
Lab: Blower door and wind turbine.

Topic 7. Ventilation systems. Natural ventilation: types and constructive elements. Criteria for determining the volumetric air flow rate.
(2 h Lecture / 2 h Workshop; Laboratory)
Natural Ventilation and Mechanical Ventilation concepts.
Single-sided ventilation, cross ventilation, and stack ventilation:
Ventilation; Natural ventilation; Occupant behavior; Habits; Window opening; Door opening; Air circulation; Airflow; Cross ventilation; Exhaust fans; Intake vents;

Seminar:
Lab: Blower door and wind turbine.

Topic 8. Mechanical ventilation.
(2 h Lecture / 3 h Workshop; Laboratory)
Basics and criteria for determining volumetric rate of airflow during mechanical ventilation. Effectiveness and efficiency of ventilation. Mechanical ventilation types, classification of mechanical air ventilation systems, Advantages and disadvantages.

Seminar:
Lab: Blower door and wind turbine.

Topic 9. Human thermal comfort, mechanisms of thermoregulation. Thermal comfort assessment models.
(2 h Lecture / 3 h Workshop; Laboratory)
Thermal comfort; Human comfort; Indoor comfort; Comfort perception; Thermal sensation; Subjective comfort; Objective comfort; Environmental factors; Personal factors; Air temperature; Radiant temperature; Air velocity; Humidity; Clothing insulation; Metabolic rate; Thermal balance; Adaptation; Neutral temperature; Comfort zone; Predicted mean vote (PMV); Predicted percentage dissatisfied (PPD); Thermal environment; Building design; Occupant behavior; Seasonal variations; Climate conditions; Building codes; Occupant satisfaction; Productivity; Health and well-being; Ergonomics; Thermal stress; Thermal physiology; Thermal comfort standards.

Topic 10. Air conditioning systems, principles of operation, types and classification, efficiency of operation.
(2 h Lecture / 3 h Workshop; Laboratory)
Individual "split" type systems, "multi-split" systems, VRF systems, "package" type systems, central systems.
Chiller; HVAC; Air conditioning; Cooling system; Refrigeration; Chilled water system; Cooling tower; Evaporator; Condenser; Compressor; Expansion valve; Refrigerant; Heat exchanger; Energy efficiency; Cooling capacity; Chilled water temperature; Load profile; Cooling load; Variable speed drive; Efficiency ratio; COP (Coefficient of Performance); Energy consumption; Maintenance; Chiller plant; Building management system (BMS); Cooling coil; AHU (Air Handling Unit); Heat rejection; Evaporative cooling; Water-cooled chiller; Air-cooled chiller; Centrifugal chiller; Scroll chiller; Absorption chiller; Energy management; Thermal comfort; Sustainable design; Environmental impact; Building operation; Performance optimization.

Seminar:
Lab: HVAC system

Topic 11: Residential space heating installations, operating principles, types, and methods of heat distribution in indoor environments.
(3 h Lecture / 3 h Workshop; Laboratory)
Geothermal energy; Ground-source heat pump; Geothermal heat pump; Earth energy system; Renewable energy; Heat transfer; Heat exchange; Ground loop; Vertical loop; Horizontal loop; Ground heat exchanger; Geothermal well; Borehole; Closed-loop system; Open-loop system; Direct exchange system; Heat extraction;

Heat rejection; Underground temperature; Earth's thermal gradient; Geothermal resources; Geothermal heating; Geothermal cooling; Energy efficiency; Sustainable design; Renewable heating and cooling; Climate control; Thermal comfort; Energy savings; Green building; Environmental impact; Geothermal heat exchanger; Groundwater flow; Geology; Hydrogeology; Thermal energy storage; Building operation; Energy management; Performance optimization.

Seminar:
Lab: Geothermal system.

Topic 12. Solar energy for air heating in residential spaces, sanitary water heating. Heating sanitary water alternatives for residential use.
(3 h Lecture / 3 h Workshop; Laboratory)
Basic components of a system, methods and their efficiency:
Solar panels; Solar thermal systems; Solar water heating; Solar collectors; Solar energy; Renewable energy; Sanitary water; Hot water; Domestic hot water (DHW); Water heating system; Solar;
Solar water heater; Flat-plate collectors; Evacuation tube collectors; Heat exchanger; Circulation pump; Solar storage tank; Backup heater; Solar fraction; Solar irradiance; Heat transfer fluid; Glycol solution; Direct system; Indirect system; Passive solar water heating; Active solar water heating; Energy efficiency; Environmental impact; Energy savings; Renewable heating; Solar thermal technology; Solar incentives; Installation; Operation;
Performance optimization.

Seminar:
Lab: Geothermal system

Topic 13. Lighting parameters, vision, light, illumination, and visual comfort. Quantitative and qualitative assessment of lighting.
(3 h Lecture / 3 h Workshop; Laboratory)
Light waves, colors; visual perception; basic parameters used for the assessment of lighting (qualitative and quantitative); Importance of quality lighting.

Topic 14. Light generation. Natural and artificial lighting. Main components of lighting systems. Electric lighting control systems.
(3 h Lecture / 3 h Workshop; Laboratory)
Natural light; Daylight; Luminous flux; Luminance; Illuminance; Lighting design; Lighting fixture; Light source; Lamp; Bulb; LED; (Light Emitting Diode); Incandescent; Fluorescent; Compact fluorescent lamp (CFL); Halogen; High-intensity discharge (HID); Color temperature; Color rendering index (CRI); Lighting control; Dimming; Motion sensor; Occupancy sensor; Daylight harvesting; Task lighting; Ambient lighting; Accent lighting; Architectural lighting; Landscape lighting; Street lighting; Emergency lighting; Lighting efficiency; Energy efficiency; Lighting standards; Lighting codes; Lighting regulations; Lighting technology; Lighting maintenance; Lighting retrofit; Lighting layout; Lighting calculation; Light pollution; Glare; Shadow; Visual comfort; Lighting control system; Lighting automation; Human-centric lighting; Well-being; Productivity; Safety; Aesthetics.

	Seminar: Lab: Illuminance measurements with Testo device – practice. Topic 15. Acoustics and acoustic comfort. Physical principles of sound. Measures to reduce noise. (3 h Lecture / 3 h Workshop; Laboratory) Sound; Acoustics; Wave; Waveform; Frequency; Pitch; Wavelength; Amplitude; Intensity; Loudness; Decibel (dB); Sound pressure level (SPL); Sound waves; Compression; Rarefaction; Wave propagation; Speed of sound; Reflection; Refraction; Diffraction; Absorption; Transmission; Reverberation; Echo; Resonance; Harmonics; Overtones; Timbre; Sound source; Sound receiver; Sound transmission; Sound absorption coefficient; Sound insulation; Noise; Noise pollution; Sound quality; Acoustic impedance; Psychoacoustics; Hearing; Ear anatomy; Auditory perception; Threshold of hearing; Masking; Sound engineering; Soundproofing; Room acoustics; Architectural acoustics; Environmental acoustics; Vibration; Noise control; Noise reduction; Noise cancellation; Occupational noise; Health effects of noise.
Methodology	**Learning Evaluation Methods.** Participation during lectures and seminars and written exam. The exam will take place in physical class. **Learning Evaluation Criteria.** The learning evaluation criteria for the "Technical Physics and Plant Engineering" course are designed to ensure relevance by assessing theoretical knowledge through a final exam, aligning with course objectives. Coherence is maintained by requiring 75% attendance for exam eligibility, promoting consistent participation. The effectiveness of the intervention is measured by a cumulative scoring system where students must achieve ≥50% from both Attendance and the Final Exam to pass, ensuring the objectives are met. Efficiency is demonstrated through the balanced use of attendance and exam performance to evaluate student knowledge comprehensively. **Learning Measurement Criteria.** A 100-points scale is used for grading, with possible praise

Points	Grades
94-100	10
83-93	9
75-82	8
65-74	7
55-64	6
50-54	5
0-49	4

Final Mark Allocation Criteria.
-Participation weight 10% (mandatory)
-Written exam weight 90%

Bibliography	Required: - Dispensation for internal use, Technical Physics and Impiantistics, Dr. Dashamir Çutra. (2012) - Energy conservation in Buildings: Techniques for economical Design by C.W. Griffin. (1974). Publisher : Construction Specifications Institute; First Edition (January 1, 1974) - Light by Joachim Fischer. (2008) ISBN-13 : 978-0841603554. Publisher : h. f. ullmann; Multilingual edition (January 1, 2008) Recommended: - Introduction to architectural science. The basis of sustainable design – Steven V. Szokolay. (2004). ISBN 0 7506 58495. Publisher: Architectural Press - A guide to energy efficient ventilation – Martin W Liddament. (1996). ISBN 0 946075 85 9. - Yang, T., Clements-Croome, D.J. (2018). Natural Ventilation in Built Environment. In: Meyers, R. (eds) Encyclopedia of Sustainability Science and Technology. Springer, New York, NY. https://doi.org/10.1007/978-1-4939-2493-6_488-3 - M. Santamouris; D. Kolokotsa. (2013). Passive cooling dissipation techniques for buildings and other structures. https://doi.org/10.1016/j.enbuild.2012.11.002
Educational resources	All the equipment employed has been purchased with the reZEB budget. 1. Blower door (Tool to measure the tightness level of a closed space in order to detect air infiltration and improve energy efficiency of buildings); 2. Wind Turbine 2KW (Renewable energy technology to be connected to other systems already available in the Energy Efficiency Laboratory) 3. Solar PV panels (4kWp solar PV system to be connected to other systems already available in the Energy Efficiency Laboratory) 4. Solar PV system (Demonstrative kit for didactic purposes) 5. Design Builder Software (Advanced building performance simulation tool). 6. 2 Computers (Desktop computers able to run software for simulation) 7. Geo-Thermal System (Renewable energy technology to be connected to other systems already available in the Energy Efficiency Laboratory)

Annex 3: Professional College of Tirana (KPT)

MODULE: HVAC AND COOLING CONTROL SYSTEMS

Institution	Professional College of Tirana (KPT)
Module (Title)	**HVAC AND COOLING CONTROL SYSTEMS**
Full Name of the Professor	Msc. ARTUR RUZI
Hours:	21 hours lecture - 24 exercises/seminars - 21 labs
Program	- Course of a study program in VET degree (120 ECTS, 2 years) - Study program "Airing and Conditioning Technology" - 6 ECTS - Academic year 2024- 2025 - Teaching period: First semester of the second year of the study program. - Mandatory
Learning outcomes	**Knowledge and Understanding** Students will gain the necessary knowledge and understanding on the basics of HVAC systems and their control, principles of Energy Efficiency with a special focus on buildings. In particular, students will: • know the operation and control of HVAC systems • understand the basic principles and benefits of energy efficiency in buildings. • know the different types of regulating valves and their applications • understand the role of thermal insulation in building energy efficiency • know the energy performance standards and regulations. **Capacity to apply Knowledge and Understanding**. By the end of this course, students will be able to: • identify the key drivers and motivations for improving energy efficiency. • mount, operate and maintain HVAC systems with a focus on energy efficiency. • evaluate the performance of HVAC systems and suggest improvements. • optimize and maintain ventilation systems to enhance energy efficiency. • compare different control methods and their impact on energy efficiency. • select appropriate control methods for various building types. • choose suitable valves and auxiliary devices for energy-efficient HVAC systems. • implement and manage energy-efficient control systems in VRF and VRV setups. • identify and use devices for measuring energy consumption in HVAC systems. • explain the functioning of smart HVAC control systems. • explore smart technologies for managing energy in buildings. • prepare comprehensive energy audit reports.

	Transversal Skills. Transversal skills are essential for students in this course, as they enhance students' ability to work effectively with others, and adapt to the dynamic nature of the labor market. • Ability to understand and interpret technical standards, regulations, and guidelines related to HVAC systems and energy efficiency. • Proficiency in using HVAC simulation software. • Ability to read detailed technical schematics and control diagrams. • Ability to clearly and effectively communicate technical information, both orally and in writing, to diverse audiences. • Ability to work effectively as part of a team, demonstrating strong interpersonal skills and to collaborate with peers, industry professionals, and stakeholders to achieve common goals. • Ability to collect and analyze data from HVAC systems Writing detailed reports on HVAC system performance. • Adhere to ethical standards and professional conduct in all aspects of work. • Understand the importance of safety, regulatory compliance, and environmental considerations. • Ability to engage in continuous learning and professional development to enhance skills and knowledge. • Ability to meet deadlines and deliver qualitative work. • Ability to advocate for the adoption of renewable energy sources in HVAC applications
Content	The course provides general knowledge to understand the importance of energy-efficient control methods and technologies in HVAC systems. The course contains theoretical and practical information about the control systems of HVAC systems, the working principle of HVAC control systems. **Topic 1** *(each topic is 1.5 hrs of lecture)* Introduction to thermoregulation. General knowledge and thermoregulatory advantages. Advantages of thermoregulation in achieving energy efficiency in buildings. Its impact on energy consumption and comfort. **Topic 2** Logic of a control system and the functional scheme of a simple control mode. Basic logic of HVAC control system. Functional schemes with a focus on energy saving. Measurement of energy efficiency in residences, commercial premises and production (hotels, shopping centers, etc.) **Topic 3** Components of automatic regulation systems Illustrated schemes in measuring energy efficiency in heating plants (water + gas) Overview of components and their roles in reducing energy consumption. **Topic 4** Cladding the building with the insulation method. a) Interior - floor/ceiling -> with polystyrene of different dimensions b) External - with polystyrene or rock wool, which achieves energy efficiency.

Topic 5
Automatic control systems in cooling plants. Examples and illustrated schemes.
a) Security check
b) Functional control
c) Capacity control
Introduction to systems in in cooling plants.
Examples and illustrated schemes focusing on energy efficiency operations.

Topic 6
Absorption cooling systems (ammonia NH3 and carbon dioxide CO2) to maintain energy efficiency.

Topic 7
Control scheme in heating plants. Examples and simplified schemes. Systems with:
a) Gas
b) Current
c) Pellets

Topic 8
Pellet boilers as a functional and economic choice, with an automatic system that offers comfort, with little maintenance, saves energy and does not pollute the environment.

Topic 9
The control components in the plants and functions and have a high energy efficiency (mortized example and illustrative scheme)

Topic 10
Control systems in HVAC systems. Examples and schematics. Control systems in VRF, VRN and absorption systems. Examples and energy saving schemes.

Topic 11
Main menu of the automatic control system.
a) Individual
b) Central
c) Climatic compression.
Their advantages in energy management and consumption reduction.

Topic 12
Selection criteria for efficient energy control methods. The use of 2- and 3-way, pneumatic, electro-magnetic valves, as well as auxiliary devices for water and gas. Two-pipe systems for higher energy efficiency.

Topic 13
Digital control of control devices in different systems. Factors that determine the most appropriate selection of control methods for energy efficiency (use of tools/tables) and devices for measuring energy consumption in systems (cooling, heating, ventilation, HVAC). Importance of energy monitoring in achieving efficiency goals.

Topic 14
Applicable law, policies and regulations.
National and EU standards for energy efficiency in HVAC.

	Review and Final Exam Review of key concepts. Course wrap-up. Final exam preparation: exercises cover the full breadth of problems, consistent with the course syllabus. *** **Lab 1** – Introduction to Health and Safety Regulations (Mechanical, Electrical, Thermal, Gas point of view). Equipment and Working Tools. **Lab 2** – Elements of a Control System for Energy Efficiency in Cooling and HVAC Systems: System Design **Lab 3** – Elements of a Control System for Energy Efficiency in Heating and HVAC Systems: System Design **Lab 4** – Components of a Control System in Ventilation Systems: Including 2-3 Valves, Pneumatics, and Motorized Shutters **Lab 5** – Introduction to Digital Devices for Regulating Temperature and Humidity: Programming Techniques **Lab 6** – Control and Safety Devices in VRF and VRN Water Cycle Systems **Lab 7** – Equipment for Measuring Energy, Gas, and Water Consumption in Cooling, Heating, HVAC, and Ventilation Systems
Methodology[1]	**Learning Evaluation Methods.** The examination procedure consists in 3 elements: (i) Participation and activation in exercises (ii) Laboratory/Practice (iii) Final exam **Learning Evaluation Criteria**. The evaluation is done throughout the course for different elements: Regular attendance is required in line with the allowed absence limit provided however that active participation and participation in interactive lectures is required and is part of the element (i) of evaluation. *Participation and activation in exercises* classes verify the student's knowledge and understanding of the given lectures. The lecturer through oral and /or written questions and exercises, or team work, assesses students understanding and knowledge of the delivered themes as well as triggers and encourages them to ask questions. *Participation and activation in Laboratory/Practice* verifies student's knowledge and understanding of the given lectures through practical tasks assigned to the students, whether individually or in group as the case may be; the student is assessed as well for the correct and accurate use of equipment in class, observation of health and safety rules and regulations while working; When case study are assigned, student's understanding of the case, the ability to analyze information, extract

[1] Methodology is based on the provisions of the Regulation of KPT, Regulation of the study program "Technology of Electrical Installations" in KPT.

information, deduct from a larger pool of information to smaller clusters, and reach to a conclusion/finding are evaluated from the professor.
For different lab works, students prepare a written document, namely Laboratory Report, that depicts all the steps undertaken by the student for a given Lab Topic, from the respective theory to its implementation in practice from the student.

The final exam is written and consists of 60 points in total, with questions exploring the topics delivered during the lectures. Mostly answers need to be explanatory and /or there are exercises to be solved in consideration of the lecture and labs. Multiple Choice, True/ False are rarely used in the final exam. The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course.

Participation in industry visits is mandatory. The costs are covered from KPT. The lecturer initiates the procedure for a field visit by preparing the relevant document with the location, topics to be explored and expected learning outcomes (agenda) and the related costs. The document is subject of approval from the Head of Department. Students are questioned during the visit and back in class.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise, whereas 0 - 40 points indicate failure.

Points	Grade	In Letters
96-100	10	A
91-95	10	A-
86-90	9	B+
81-85	9	B
76-80	8	B-
71-75	8	C+
66-70	7	C
61-65	7	C-
56-60	6	D+
51-55	6	D
46-50	5	D-
41-45	5	E
0-40	4	F

Final Mark Allocation Criteria
10% - Participation and activation in exercises
30% - Laboratory/Practice
60% - Final exam

Bibliography

Mandatory: Textbook of lectures prepared by the course lecturer.

Recommended:

- Electricity and Electronics for HVAC 1st Edition, by Rex Miller, Mark R. Miller, 2007, ISBN 13 978-0071496681.
- "Heating, Ventilation, and Air Conditioning: Analysis and Design" by Faye C. McQuiston, Jerald D. Parker, and Jeffrey D. Spitler
- "Energy Management Handbook" by Wayne C. Turner and Steve Doty

	• "Principles of Heating, Ventilation, and Air Conditioning in Buildings" by John W. Mitchell and James E. Braun • "Building Automation: Control Devices and Applications" by Ingo Weidmüller and Klaus W. Voss • "Smart Buildings Systems for Architects, Owners, and Builders" by James Sinopoli Standards and Guidelines • EU Directives and Regulations that relate to HVAC systems and energy efficiency • ASHRAE Standards 90.1 and 62.1 • LEED (Leadership in Energy and Environmental Design) • Energy Star Guidelines for Energy Management Materials: Selected readings and case studies that may be provided by the course lecturer. Articles and Papers • "Energy Efficiency in Buildings: HVAC and Controls" by John P. Meyer • "Improving Energy Efficiency in HVAC Systems" by ASHRAE Journal • "Demand-Controlled Ventilation: A Case Study" by Lawrence Berkeley National Laboratory • "Energy Recovery Ventilation Systems: Overview and Applications" by the U.S. Department of Energy • "Building Energy Management Systems: Applications to Low-Energy HVAC and Natural Ventilation Control" by Gerhard Schweiger et al.
Educational resources	During the course, lectures delivery will be accompanied with PowerPoint presentations, video simulations, with various software and real equipment. The lectures aim to be interactive to trigger their attention. Exercises on the delivered lectures as well as a knowledge check in class. Laboratories are conducted in smaller groups by working in team and /or alone with physical installations /workstations. Desktops will be used to run SW for simulation, including the HVAC license purchased within the project. 1 inverter and 400WA batteries for their use as energy storage system will be used as well. Online Resources • U.S. Department of Energy (DOE) – Energy Efficiency and Renewable Energy (EERE) • ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) • Building Green https://www.buildinggreen.com/ • https://dps.gov.al/images/upload/pdf/Katalogu_i_Standardeve_Shqiptare_2019.pdf Case Studies: Review of real-world energy audits, that will include group discussion on lessons learned and best practices Industry Visits: Site visits to industries and facilities for practical exposure on the central HVAC control systems.

MODULE: ENGINEERING MATERIALS/METROLOGY

Institution	Professional College of Tirana (KPT)
Module (Title)	**ENGINEERING MATERIALS/METROLOGY**
Full Name of the Professor	Ing. MSc. Piro Dhimitri
Hours:	21 hours lecture - 24 exercises (seminar) - 21 labs
Program	- Course of a study program in VET degree (120 ECTS, 2 years) - B category[2] - Study program "Automotive Technology", "Electro Mechanics", Airing and Conditioning Technology", "Construction Technology" - 6 ECTS - Academic year 2024- 2025 - Teaching period: first semester of the second year of the study program - Mandatory
Learning outcomes	**Knowledge and Understanding** The Course deals with basic knowledge on engineering materials and metrology, completing the general education of the student. The course contains knowledge of metals and metal alloys, ceramics, polymers and composites, their properties, selection for practical use. The students will acquire knowledge of: • the methods of production of materials, micro and macro construction of materials as well as construction internal energies and their efficient use. • measuring devices, measurement methods and testing And understanding of: • the influence of engineering materials used in various industries (such as mechanics, automobiles, construction, etc.) on energy balance. • the role of metrology and its basics • standards, units of measurement, and calibration techniques • the importance of surface metrology in manufacturing and quality control. • the legal and regulatory requirements related to measurement and calibration. **Capacity to apply Knowledge and Understanding** The course will ensure that students will not only understand the theoretical aspects but also effectively apply their knowledge in practical, real-world settings to achieve tangible results. At the end of the course students will be able to: • classify materials into categories such as metals, ceramics, polymers, and composites, and explain their key characteristics (SI standard).

[2] Based on the provisions of Decision of the Council of Ministers no.41, dated 24.1.2018, "On the elements of study programs offered by institutions of higher educations", as amended, Appendix A, Table 1.1 that refers to level 5 study programs, courses are divided into categories from A to E.
B Type Course is CHARACTERISTIC Course - Preparation for the discipline that characterizes the program, practical courses 45–55% (credits)

	• explain the relationship between the microstructure of materials and their macroscopic properties. • analyze how processing techniques influence material properties and performance. • conduct different material testing methods, including tensile, compression, hardness, and impact tests. • use various measurement techniques and instruments such as calipers, micrometers, (manual, mechanical, and electronic), gauges, CNC etc. • measure surface roughness, texture, and form using appropriate techniques. **Transversal Skills** Transversal skills are essential for students in this course, as they enhance students' ability to apply technical knowledge in real-world contexts, work effectively with others and adapt to the dynamic nature of the labor market. • Ability to use diverse methods and tools of communication to communicate clearly and unambiguously technical information and findings through written reports and/or presentations with specialist and non-specialist audiences in national and international contexts. • Prioritize tasks and manage time efficiently to meet deadlines. • Stay up to date with evolving technologies and regulatory standards. • Adhere to ethical standards. • Ability to function effectively as a valuable team member. • Maintain professionalism in interactions with clients and stakeholders/third parties.
Content	This course provides an in-depth overview of engineering materials and metrology with a focus on energy efficiency. It covers material properties, selection, testing, and measurement techniques that contribute to the development of energy-efficient systems and processes. Emphasis will be on sustainable materials and technologies, precision measurement, and quality control in applications. The relationship between the course of Engineering Materials/Metrology and energy efficiency is multifaceted and crucial for the development of sustainable engineering solutions. **Topic 1 - Introduction to Engineering Materials and Energy Efficiency** *(each topic is 1.5 hrs of lecture)* Introduction to Engineering Materials and Energy Efficiency Overview of materials science. Importance of Energy Efficiency. Relationship between material properties and energy consumption in different environment (i.e: construction etc.) **Topic 2 - Properties of Engineering Materials** Properties of Engineering Materials. Mechanical properties: strength, ductility, hardness. Thermal properties: conductivity, expansion, heat capacity. Temperature measuring devices Electrical properties: conductivity, resistivity. Environmental properties: corrosion resistance, recyclability. **Topic 3 - Metal and metal alloys, classification, properties** Metals and metal alloys. Classification of metals and metal alloys. State diagrams of metallic alloys and their physical-chemical and mechanical properties. **Topic 4 - Polymers**

Polymers. Development of polymers and their importance.
Classification of plastic materials. Properties of polymers (thermoplastic, elastomer (rubber) and thermosets) Their use in the automotive, construction, electro-mechanical industry, etc.

Topic 5 - Polymers' properties
Chemical, physical, and mechanical properties of polymers: Laboratory tests and their characteristics (thermoset, elastomer, and thermoplastic). Engineering use of polymers, recycling and their risks to the community.
The influence of polymers on heat transmission and the effect of this property on mechanical properties

Topic 6 – Ceramics, classification, properties
Ceramics - What are ceramics, their chemical properties
Engineering classification of ceramics. Impact on energy balances of ceramics based on coefficients of energy conductivity and linear swellings due to heat.
Laboratory tests of ceramics and their application.
Piezoceramics and super advanced ceramics (carbon fiber, etc.)

Topic 7 - Non-ferrous alloys and their properties
Mechanical properties and use of non-ferrous metal alloys. Copper alloys.

Topic 8 - Non-ferrous alloys and their properties 2
Aluminum Alloys. Magnesium Alloys. Some non-ferrous metals

Topic 9 - Composite materials, their use and applications
Composite materials. Composites - What are composites, how are they created and why do they serve us?
Composite matrices and their engineering application. Influence of heterogeneous composites on heat transmission.

Topic 10 - Metrology and Measurement Techniques
Metrology and Measurement Techniques
Introduction to metrology: definitions and standards.
Precision measurement tools and techniques.
Statistical methods in measurement and quality control.

Topic 11- Measurements methods and devices.
Control methods. Dimensional measuring devices. Micrometers
Calibers. Calibration and maintenance of measurement instruments.

Topic 12 - Structural Analysis via Surface and Metallographic Electron Microscopy
Surface and metallographic electron microscopy
The structural influence on the physical-mechanical properties of materials and on the internal energy of the microparticle, the connection of physical chemistry to the properties of materials.

Topic 13 – Thermal balance. The influence of engineering materials
The influence of engineering materials on the thermal balance in industry. Smart materials and their role in energy conservation.

Topic 14 - Case Studies and Applications

	Case studies on energy-efficient materials in industries. The impact of engineering materials on energy efficiency in our lives. Engineering calculations of the energy balance (example in a residential building). Related National and EU standards. The global challenges of energy sustainability and the development of technologies that reduce our environmental footprint. **Review and Final Exam** Review of key concepts. Course wrap-up. Final exam preparation: exercises cover the full breadth of problems, consistent with the course syllabus. *** **Lab 1** Health and Safety at work. Temperatures, their measurements and respective equipment (thermometer with three units of measurement. Laser beam pyrometers such as medical ones etc). **Lab 2** Macro structures and micro structures. Metallographic microscopy Magnetic properties of metallic alloys **Lab 3** Measurements with mechanical and digital calipers [Manual mechanical calipers / electronic calipers] **Lab 4** Mechanical and digital micrometer measurements [Manual mechanical micrometers/electronic micrometers] **Lab 5** Technological properties of engineering materials: Weldability - Mechanical processing **Lab 6** Ceramics in application (refractory coatings) **Lab 7** Properties of polymer joints Heat and silicone joints. The impact of shell processes on energy balances in homes.
Methodology[3]	**Learning Evaluation Methods.** The examination procedure consists in 3 elements: (iv) Participation and activation in exercises (v) Laboratory/Practice (vi) Final exam **Learning Evaluation Criteria**. The evaluation is done throughout the course for different elements: Regular attendance is required in line with the allowed absence limit provided however that active participation and participation in interactive lectures is required and is part of the element (i) of evaluation. *Participation and activation in exercises* classes verify the student's knowledge and understanding of the given lectures. The lecturer through oral and /or written questions and exercises, or team work, assesses students understanding and knowledge of the delivered themes as well as triggers and encourages them to ask questions.

[3] Methodology is based on the provisions of the Regulation of KPT, Regulation of the study programs in KPT.

Participation and activation in Laboratory/Practice verifies student's knowledge and understanding of the given lectures through practical tasks assigned to the students, whether individually or in group as the case may be; the student is assessed as well for the correct and accurate use of equipment in class, observation of health and safety rules and regulations while working; When case study are assigned, student's understanding of the case, the ability to analyze information, extract information, deduct from a larger pool of information to smaller clusters, and reach to a conclusion/finding are evaluated from the professor.
For different lab works, students prepare a written document, namely Laboratory Report, that depicts all the steps undertaken by the student for a given Lab Topic, from the respective theory to its implementation in practice from the student. For each lab work above is provided the respective assessment method.
The lecturer aims to ensure that the learning objectives are met, students remain engaged throughout the course, and the course content is both relevant and impactful. While interacting with students through various forms, the lecturer will consider if the content of the course is comprehensive, relevant to the current trends, and easy to understand. In the same time, the lecturer when making the assessment needs to consider other elements, such as if there are adequate resources (readings, videos, external links) provided to support learning, has student developed the necessary skills, knowledge, or competencies by the end of the course, can student apply what he/she has learned in real-world or practical scenarios, can student use the equipment by him/herself etc.

The final exam is written and consists of 60 points in total, with questions exploring the topics delivered during the lectures. Mostly answers need to be explanatory and /or there are exercises to be solved in consideration of the lecture and labs. Multiple Choice, True/ False are rarely used in the final exam. The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course.

The final exam is a crucial component of course evaluation, and along the two other elements, it serves as a comprehensive assessment of students' understanding and mastery of the course content. The final exam assesses the key concepts, skills, and knowledge outlined in the course's learning objectives. The distribution of questions reflects the emphasis placed on different topics throughout the course, ensuring that major areas are appropriately weighed. It uses a mix of question types (e.g., multiple-choice, short answer, essays, problem-solving) to assess different levels of learning, from basic recall to higher-order thinking and application. The exam includes a range of question difficulties, from basic to advanced, to accurately reflect the students' overall understanding and skills.
The exam is designed by the lecturer and approved by the Head of the Department. Based on the provisions of KPT regulation and the regulation of the study program, the exam content remains secure before and during administration, and that it is only accessible to those authorized to take or administer the exam. Exams are usually written. Exams are conducted anonymously, being equipped with barcode until the assessment is done.
The content of the exam ensures that all questions and instructions are clearly worded to avoid ambiguity, which can lead to confusion and misinterpretation. The exam is designed to be completed within the allotted time. The student's grading is detailed for each question and is recorded on the exam paper, in ink, and on the student assessment summary table. Upon the exam, students are entitled to a review session where students can ask questions about the exam and understand the correct answers, further reinforcing learning.

[more details on the exam are provided in the regulation of KPT and the study program regulation].

Participation in industry visits is mandatory. The costs are covered from KPT. The lecturer initiates the procedure for a field visit by preparing the relevant document with the location, topics to be explored and expected learning outcomes (agenda) and the related costs. The document is subject to approval from the Head of Department. Students are questioned during the visit and back in class.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise, whereas 0 - 40 points indicate failure.

Points	Grade	In Letters
96-100	10	A
91-95	10	A-
86-90	9	B+
81-85	9	B
76-80	8	B-
71-75	8	C+
66-70	7	C
61-65	7	C-
56-60	6	D+
51-55	6	D
46-50	5	D-
41-45	5	E
0-40	4	F

Final Mark Allocation Criteria
10% - Participation and activation in exercises
30% - Laboratory/Practice
60% - Final exam

Bibliography

Mandatory: Textbook of lectures prepared by the course lecturer.

Recommended:

- "Materials Science and Engineering: An Introduction" by William D. Callister and David G. Rethwisch, ISBN: 978-1-118-32457-8
- W. BOLTON "Engineering materials technology", Second Edition, 2012, ISBN-10: 0750617403
- Krishan K. Chawla "Composite Materials: Science and Engineering", University of Alabama at Birmingham, Al,35294, USA, 2012
- Yip-Wah Chung, Monica Kapoor ''Introduction to materials science and engineering'' Second Edition, OXFORD, 2018
- Laboratory manuals and metrology guidelines.

Supplementary Materials: Selected readings and case studies that may be provided by the course lecturer.

Educational resources

During the course, lectures delivery will be accompanied with PowerPoint presentations, video simulations, and simulations with various software and real

	equipment. The lectures aim to be interactive to trigger their attention and to make the teaching process more inclusive. Laboratories are conducted in smaller groups by working in team and /or alone with physical installations /workstations. The new purchased desktops under the project will be used to be connected with the microscope (already in KPT) for the structural analysis (Lab work no. 2), to run SW for renewable energies, for simulation, video etc. as well. Thermocouples will be used in Lab work no. 1 and hygrometer in Lab work no. 6 etc. Both thermocouples and hygrometer purchased within the project. Industry Visits: Site visits to industries and facilities for practical exposure.

Institution	Professional College of Tirana (KPT)
Module (Title)	**APPLIED THERMOTECNICS**
Full Name of the Professor	Msc. Piro DHIMITRI
Hours:	21 hours lecture - 30 exercises - 10 labs
Program	- Course of a study program in VET degree (120 ECTS, 2 years) - Study program "Electro-Mechanics", "HVAC", "Vehicles Technology" - 6 ECTS - Academic year 2024- 2025 - Teaching period: Second semester of the first year of the study programs above - Mandatory
Learning outcomes	**Knowledge and Understanding** Throughout the course, students will acquire: • a solid understanding of the basic principles of thermodynamics, including system equilibrium and energy balance, including the laws of thermodynamics, state functions, and the behavior of gases, liquids, and solids in various thermodynamic processes. • the ability to identify and apply state parameters and equations to analyze working bodies. • the understanding of the fundamental relationship between energy and work in thermodynamic processes. • knowledge of the properties of gases and vapors, and their impact on the efficiency of thermodynamic cycles. • the understanding of the heat transfer mechanisms: conduction, convection and radiation, including practical applications in engineering systems. • proficiency in the operation and analysis of thermotechnical devices, with a focus on optimizing their thermal and energy balances to enhance energy efficiency and savings. **Capacity to apply Knowledge and Understanding** By the end of this course, students will be: • able to apply their knowledge and understanding of thermotechnics to real-world challenges. • able to diagnose and solve thermotechnical problems, using the theoretical knowledge gained during the course. This includes analyzing energy systems, optimizing thermal processes, and designing efficient solutions for various applications. • able to apply principles of thermodynamics, heat transfer, and fluid dynamics to create systems that are not only functional but also energy-efficient and environmentally sustainable.

	• proficient in implementing energy efficiency measures across different thermotechnical systems. • able to execute and manage projects effectively: to implement projects related to thermotechnics, ensuring that they meet technical specifications, adhere to timelines, and stay within budget constraints. • able to quickly adapt to new technologies and methodologies in the field of thermotechnics. They will be prepared to continuously update their skills and apply the latest innovations to improve system performance and sustainability. • able to evaluate and optimize the performance of energy conversion systems. **Transversal Skills**. Transversal skills are essential for students in this course, as they enhance students' ability to work effectively with others, and adapt to the dynamic nature of the labor market. • Competence in planning, executing, and managing projects within the field of thermotechnics • Ability to clearly and effectively communicate technical information, both orally and in writing, to diverse audiences. • Ability to work effectively as part of a team, demonstrating strong interpersonal skills and to collaborate with peers, industry professionals, and stakeholders to achieve common goals. • Ability to adhere to ethical standards and professional conduct in all aspects of work. • Understand the importance of safety, regulatory compliance, and environmental considerations. • Ability to engage in continuous learning and professional development to enhance skills and knowledge. • Encourage to appreciate diverse perspectives and approaches in addressing global energy challenges. • Ability to make decisions that promote sustainability and social responsibility. • Proficiency in using modern digital tools, software, and technologies relevant to thermotechnics
Content	This course is a fundamental discipline essential for students' understanding of thermotechnics. It covers key concepts such as thermodynamic systems, equilibrium states, and the principles governing energy balance. The course delves into the mechanisms of heat transfer, the relationship between energy and work, and various types of work within a thermodynamic context. It also examines the properties of gases and vapors and their applications in thermotechnical processes. A major focus of the course is on the laws of thermodynamics and the operation of thermotechnical equipment, emphasizing the efficient use of energy in these systems. This includes an exploration of energy transmission methods, calculations for energy transit, and the design of heat transmission diagrams for various thermotechnical systems. **Topic 1** *(each topic is 1.5 hrs of lecture)*

Thermodynamic (TD) System, Equilibrium status parameters, Condition equation, TD system energy, Heat, Thermal energy of heat. Importance of energy-efficient systems and thermodynamic efficiency.

Topic 2
Body of work. Real gas and Vapor and their appearances. The equation of the ideal steam gas state. Phase transformations of the subjects. Mechanic Energy. P-V Diagram

Topic 3
The 1st law of TD. The equivalence between work and heat. Analytical expressions of the 1st law of TD. Enthalpy. Engines and compresses -leakage pages. Tubs. Diffuser, Throttling. How the first law of thermodynamics is fundamental to energy conservation and efficiency in practical systems, such as in power plants and heat recovery steam generators.

Topic 4
The 2nd law of TD. Entropy. Cycles of thermal machinery.The concept of entropy. Properties. Entropy balance. Open systems. Entropy in everyday life. Release and recovery of energy during the entropy process/change.The role of the second law of thermodynamics in evaluating the efficiency of thermal systems. Entropy reduction in industrial processes, and their relation to sustainable energy production.

Topic 5
Energy Quality. Heat. Exergy. Currency Real Work and Exergy Loss. Combustion processes. Combustible substances. Stoichiometric ratio. Application of TD laws in chemical reactions.

Topic 6
Analysis and evaluation of combustion processes. Combustion gases. Combustion products and the environment. Combustion process yield. Losses. Compression and expansion of gases and vapors. Compressor efficiency.

Topic 7
Multistage compressors. Flow of gases and vapors. Diffuser, throttling. Ejector and centrifugal compressors. Cycles of work generating plants. Gas engines.

Topic 8
Energy Efficiency in Thermodynamic Cycles: Internal Combustion Engines, Gas Plants, and Turbines. Cycles of internal combustion engines. Cycles of gas plants and turbines. Cycles of turbojet engines. Cycles of Internal Combustion Engines and Turbines. Efficiency. Cycles with overheating.

Topic 9
Steam-gas combined cycles. Binary cycle. Cycles of cooling plants and heat pumps. Triple point parameters. Carnot cycle of refrigeration. Moist air. Diagram H-d

Topic 10
Comfort and air conditioning. Humid air processing. Simple heating and cooling. Concept of heat transfer. Temperature field and gradient. Heat flow.

Topic 11

Thermal conductivity. Flat wall. Curved wall. Concept of thermal resistance. Thermal conductivity through composite bodies. Influences of contact method.

Topic 12
Convection. Heat transfer coefficient by convection. Forced and natural convection mechanism Velocity boundary layers Laminar and turbulent flow.

Topic 13
Analytical method Similarity theory. Similarity criteria and criterion equations. Variable phase state. Condensation of steam. Radiation and laws of resonance

Topic 14
Characteristics of radiation. Radiation and the laws of radiation. The coefficients. Absorption. Radiation of gases and vapors. Solar atmospheric radiation. Greenhouse effect. Transmission on the flat wall.

Review and Final Exam Preparation
Review of key concepts. Course wrap-up. Final exam preparation: exercises cover the full breadth of problems, consistent with the course syllabus.

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Lab Work No. 1 Work Health and Safety. System Efficiency Analysis
Duration: 3 hours
Objective: Students will learn about safety protocols and standards specific to thermotechnical systems, with an added focus on analyzing and optimizing system efficiency.

Tasks:

- Conduct a safety assessment of thermotechnical equipment, identifying potential hazards and implementing safety measures.
- Perform an efficiency analysis of a thermotechnical system, evaluating energy losses and proposing improvements for safer and more efficient operation.

Lab Work No. 2 State Transformation and Energy Optimization
Duration: 3 hours
Objective: Students will explore the state transformation emphasizing the energy implications and efficiency of the process.

Tasks:

- Experiment with the phase change of fluids, monitoring temperature, pressure, and energy input/output.
- Analyze the efficiency of the transformation process, calculating energy utilization and identifying ways to optimize the process for reduced energy consumption.

Lab Work No. 3 Thermotechnical Work Body and Fuel Efficiency Analysis
Duration: 4 hours
Objective: Students will investigate the properties and performance of thermotechnical work bodies, focusing on equipment operation and fuel efficiency.

Tasks:

	• Examine different types of thermotechnical equipment and fuels, assessing their efficiency and environmental impact. • Conduct experiments to measure the thermal and energy performance of the work bodies, identifying opportunities for improving fuel efficiency and reducing emissions.
Methodology[4]	**Learning Evaluation Methods**. The examination procedure consists in 3 elements: (vii) Participation and activation in exercises (viii) Laboratory/Practice (ix) Final exam **Learning Evaluation Criteria**. The evaluation is done throughout the course for different elements: Regular attendance is required in line with the allowed absence limit provided however that active participation and participation in interactive lectures is required and is part of the element (i) of evaluation. *Participation and activation in exercises* classes, verify the student's knowledge and understanding of the given lectures. The lecturer through oral and /or written questions and exercises, or team work, assesses students understanding and knowledge of the delivered themes as well as triggers and encourages them to ask questions. *Participation and activation in Laboratory/Practice* verifies student's knowledge and understanding of the given lectures through practical tasks assigned to the students, whether individually or in group as the case may be; the student is assessed as well for the correct and accurate use of equipment in class, observation of health and safety rules and regulations while working; When case study are assigned, student's understanding of the case, the ability to analyze information, extract information, deduct from a larger pool of information to smaller clusters, and reach to a conclusion/finding are evaluated from the professor. For different lab works, students prepare a written document, namely Laboratory Report, that depicts all the steps undertaken by the student for a given Lab Topic, from the respective theory to its implementation in practice from the student. For each lab work above is provided the respective assessment method. The lecturer aims to ensure that the learning objectives are met, students remain engaged throughout the course, and the course content is both relevant and impactful. While interacting with students through various forms, the lecturer will consider if the content of the course is comprehensive, relevant to the current trends, and easy to understand. In the same time, the lecturer when making the assessment needs to consider other elements, such as if there are adequate resources (readings, videos, external links) provided to support learning, has student developed the necessary skills, knowledge, or competencies by the end of the course, can student apply what he/she has learned in real-world or practical scenarios, can student use the equipment by him/herself etc. *The final exam* is written and consists of 60 points in total, with questions exploring the topics delivered during the lectures. Mostly answers need to be explanatory and /or there are exercises to be solved in consideration of the lecture and labs. Multiple

[4] Methodology is based on the provisions of the Regulation of KPT, Regulation of the study program "Technology of Electrical Installations" in KPT.

Choice, True/ False are rarely used in the final exam. The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course.

The final exam is a crucial component of course evaluation, and along the two other elements, it serves as a comprehensive assessment of students' understanding and mastery of the course content. The final exam assesses the key concepts, skills, and knowledge outlined in the course's learning objectives. The distribution of questions reflects the emphasis placed on different topics throughout the course, ensuring that major areas are appropriately weighed. It uses a mix of question types (e.g., multiple-choice, short answer, essays, problem-solving) to assess different levels of learning, from basic recall to higher-order thinking and application. The exam includes a range of question difficulties, from basic to advanced, to accurately reflect the students' overall understanding and skills.
The exam is designed by the lecturer and approved by the Head of the Department. Based on the provisions of KPT regulation and the regulation of the study program, the exam content remains secure before and during administration, and that it is only accessible to those authorized to take or administer the exam. Exams are usually written. Exams are conducted anonymously, being equipped with barcode until the assessment is done.
The content of the exam ensures that all questions and instructions are clearly worded to avoid ambiguity, which can lead to confusion and misinterpretation. The exam is designed to be completed within the allotted time. The student's grading is detailed for each question and is recorded on the exam paper, in ink, and on the student assessment summary table. Upon the exam, students are entitled to a review session where students can ask questions about the exam and understand the correct answers, further reinforcing learning.
[more details on the exam are provided in the regulation of KPT and the study program regulation].

Participation in industry visits is mandatory. The costs are covered from KPT. The lecturer initiates the procedure for a field visit by preparing the relevant document with the location, topics to be explored and expected learning outcomes (agenda) and the related costs. The document is subject of approval from the Head of Department. Students are questioned during the visit and back in class.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise, whereas 0 - 40 points indicate failure.

Points	Grade	In Letters
96-100	10	A
91-95	10	A-
86-90	9	B+
81-85	9	B
76-80	8	B-
71-75	8	C+
66-70	7	C
61-65	7	C-
56-60	6	D+
51-55	6	D
46-50	5	D-
41-45	5	E
0-40	4	F

	Final Mark Allocation Criteria 20% - Participation and activation in exercises 20% - Laboratory/Practice 60% - Final exam
Bibliography	Mandatory: Textbook of lectures prepared by the course lecturer. "Termoteknikë e aplikuar", Ing.MSc. P.Dhimitri 2020 (and as updated) Recommended: • Prof. Dr. A. Shtjefni "TERMOTEKNIKA TEKNIKE", Tirana, 2008 • Ismail Demneri, "Termoteknika", Tirane, 2013 • Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 2006 • "Thermodynamics: An Engineering Approach", Yunus A. Çengel & Michael Boles Supplementary Materials: Other selected readings and case studies as may be provided case by case by the course lecturer.
Educational resources	During the course, lectures delivery will be accompanied with PowerPoint presentations, video simulations, with various software and real equipment. The lectures aim to be interactive to trigger their attention. The new purchased desktops under the project will be used during lectures. Exercises on the delivered lectures as well as a knowledge check in class. Laboratories are conducted in smaller groups by working in team and /or alone with physical installations /workstations. Industry Visits: Site visits to industries and facilities for practical exposure.

Institution	Professional College of Tirana (KPT)
Module (Title)	**ENERGY ALLOCATION AND USE**
Full Name of the Professor	MP. Spartak PALAMANI
Hours:	21 hours lecture - 24 exercises/seminars - 21 labs
Program	- Course of a study program in VET degree (120 ECTS, 2 years) - Study program "Technology of Electrical Installations" - 6 ECTS - Academic year 2024- 2025 - Teaching period: First semester of the second year of the study program - Mandatory
Learning outcomes	**Knowledge and Understanding** • Knowledge of power systems fundamentals. • Understanding of the structure, components, and functioning of electrical power systems, including generation, transmission, and distribution. • Ability to distinguish between different types of power plants. **Capacity to apply Knowledge and Understanding**. The course will ensure that students will not only understand the theoretical aspects of energy use and allocation but also effectively apply their knowledge in practical, real-world settings to achieve results. Therefore, by the end of this course students will be able to: • identify and describe various methods of electricity supply to urban, industrial, and rural consumers. • perform accurate calculations of electrical loads for residential, commercial, and industrial sectors. • know and comply with regulations and standards: demonstrate knowledge of national and international standards and regulations governing power distribution; ensure adherence to safety protocols and compliance requirements in electrical distribution projects. • apply methods and technologies to improve energy efficiency in power distribution systems and to implement energy conservation techniques to reduce overall energy consumption **Transversal Skills**. Transversal skills are essential for students in this course, as they enhance students' ability to work effectively with others and adapt to the dynamic nature of the labor market. • Ability to clearly and effectively communicate technical information, both orally and in writing, to diverse audiences. • Ability to work effectively as part of a team, demonstrating strong interpersonal skills and to collaborate with peers, industry professionals, and stakeholders to achieve common goals.

	• Adhere to ethical standards and professional conduct in all aspects of work. • Understand the importance of safety, regulatory compliance, and environmental considerations. • Ability to engage in continuous learning and professional development to enhance skills and knowledge. • Trigger curiosity to develop new ideas and approaches to improve power distribution systems and practices. • Encourage to appreciate diverse perspectives and approaches in addressing global energy challenges.
Content	The course provides general knowledge about the power system and the electrical supply network for urban, industrial, and rural consumers with a special focus on energy efficiency. In a world where energy consumption is skyrocketing and environmental concerns are at the forefront, the conversation around energy efficiency is of crucial importance. **Topic 1 - Energy efficiency** *(each topic is 1.5 hrs of lecture)* Energy efficiency. Energy efficiency as the main indicator that characterizes the quality of electricity and the security of the supply of electricity to consumers from renewable energy sources. **Topic 2 - Storage solutions: Load analysis and computational methods** Storage to meet the contemporary needs of industry and society by considering factors such as average loads, root mean square loads, computational loads etc. The computing load is calculated according to two methods, according to the sum of the nominal powers and the demand coefficient, as well as according to the average power and the maximum coefficient. **Topic 3 - Schemes for the supply of electricity from renewable energy sources** Typical schemes for the supply of electricity from renewable energy sources, which are radial schemes, trunk schemes, as well as combined schemes to increase energy efficiency and security in the distribution system. **Topic 4 - Modern low-voltage protection devices for renewable energy systems** Modern disconnecting and protection devices in low voltage networks in the production of energy from water, wind and sun. What are circuit breakers, protective characteristics, their types B, C and D, as well as their selection, fuses, their selection according to the type of consumer and selectivity, as well as general knowledge about differential circuit breakers or circuit breakers. **Topic 5 - Conductor and cable sizing criteria** Calculation of the section of conductors and cables according to several criteria, which are the choice according to heating currents. **Topic 6 - Protection and voltage drop selection** Selection according to protection against short-circuit currents and overloads. Criterion according to mechanical durability, choice according to voltage drop according to EU norms, choice according to economic density, etc. **Topic 7 - Energy-efficient lighting technologies** Energy efficiency and related technology. Advanced lighting systems.

Topic 8 – SMART energy efficiency solutions
Energy efficiency in HVAC technologies, automation in SMART buildings, use of the Internet in energy management.

Topic 9 -Energy efficiency in power supply systems
Calculation of energy efficiency in the electricity supply systems of urban, industrial and rural consumers by implementing cogeneration and renewable energy sources.

Topic 10 - Optimal renewable energy plant selection
Choosing the most efficient option to meet the technical requirements of the renewable energy plant.

Topic 11- Short Circuit calculations and power factor improvement
Calculations of short circuit currents. Improving the power factor without installing compensating means.

Topic 12 - Motor replacement and power factor enhancement
Replacement of no-load asynchronous motors with motors of lower power. Improving the power factor through the installation of compensatory means. Calculation of their reactive power, where capacitor banks have the greatest use.

Topic 13 – Applicable legal framework. National and EU standards.
Policies and regulations for energy efficiency. National and EU standards for energy efficiency.

Topic 14. Novelties in energy efficiency. Introducing NZEB.
Innovations in energy efficiency technology. The concept of near-zero energy.

Review and Final Exam
Review of key concepts. Course wrap-up. Final exam preparation: exercises cover the full breadth of problems, consistent with the course syllabus.

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Lab Work No. 1 Health and safety in energy allocation and use. Construction of an electric cabin.

Lab Work No. 2 Production of electricity from hydro turbines, transmission and distribution. How to maximize the efficient use.

Lab Work No. 3 Substations 220/110/35/10 kV as an important part of the energy system. Calculation of energy efficiency.

Lab Work No. 4 Construction of a 6-35 kV medium voltage line. Calculation of energy efficiency.

Lab Work No. 5 Construction of a cogeneration system in an apartment to increase energy efficiency.

Lab Work No. 6 Construction of a distribution panel for electricity connected with photovoltaic and wind powered panels.

Lab Work No. 7 Construction of a panel with capacitor batteries for the improvement of cos fi.

Methodology[5]	**Learning Evaluation Methods**. The examination procedure consists in 3 elements: (x) Participation and activation in exercises (xi) Laboratory/Practice (xii) Final exam **Learning Evaluation Criteria**. The evaluation is done throughout the course for different elements: Regular attendance is required in line with the allowed absence limit provided however that active participation and participation in interactive lectures is required and is part of the element (i) of evaluation. *Participation and activation in exercises* classes verify the student's knowledge and understanding of the given lectures. The lecturer through oral and /or written questions and exercises, or team work, assesses students understanding and knowledge of the delivered themes as well as triggers and encourages them to ask questions *Participation and activation in Laboratory/Practice* verifies student's knowledge and understanding of the given lectures through practical tasks assigned to the students, whether individually or in group as the case may be; the student is assessed as well for the correct and accurate use of equipment in class, observation of health and safety rules and regulations while working; When case study are assigned, student's understanding of the case, the ability to analyze information, extract information, deduct from a larger pool of information to smaller clusters, and reach to a conclusion/finding are evaluated from the professor. For different lab works, students prepare a written document, namely Laboratory Report, that depicts all the steps undertaken by the student for a given Lab Topic, from the respective theory to its implementation in practice from the student. For each lab work above is provided the respective assessment method. The lecturer aims to ensure that the learning objectives are met, students remain engaged throughout the course, and the course content is both relevant and impactful. While interacting with students through various forms, the lecturer will consider if the content of the course is comprehensive, relevant to the current trends, and easy to understand. In the same time, the lecturer when making the assessment needs to consider other elements, such as if there are adequate resources (readings, videos, external links) provided to support learning, has student developed the necessary skills, knowledge, or competencies by the end of the course, can student apply what he/she has learned in real-world or practical scenarios, can student use the equipment by him/herself etc. *The final exam* is written and consists of 60 points in total, with questions exploring the topics delivered during the lectures. Mostly answers need to be explanatory and /or there are exercises to be solved in consideration of the lecture and labs. Multiple Choice, True/ False are rarely used in the final exam. The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course. The final exam is a crucial component of course evaluation, and along the two other elements, it serves as a comprehensive assessment of students' understanding and mastery of the course content. The final exam assesses the key concepts, skills, and knowledge outlined in the course's learning objectives. The distribution of questions

[5] Methodology is based on the provisions of the Regulation of KPT, Regulation of the study program "Technology of Electrical Installations" in KPT.

reflects the emphasis placed on different topics throughout the course, ensuring that major areas are appropriately weighed. It uses a mix of question types (e.g., multiple-choice, short answer, essays, problem-solving) to assess different levels of learning, from basic recall to higher-order thinking and application. The exam includes a range of question difficulties, from basic to advanced, to accurately reflect the students' overall understanding and skills.
The exam is designed by the lecturer and approved by the Head of the Department. Based on the provisions of KPT regulation and the regulation of the study program, the exam content remains secure before and during administration, and that it is only accessible to those authorized to take or administer the exam. Exams are usually written. Exams are conducted anonymously, being equipped with barcode until the assessment is done.
The content of the exam ensures that all questions and instructions are clearly worded to avoid ambiguity, which can lead to confusion and misinterpretation. The exam is designed to be completed within the allotted time. The student's grading is detailed for each question and is recorded on the exam paper, in ink, and on the student assessment summary table. Upon the exam, students are entitled to a review session where students can ask questions about the exam and understand the correct answers, further reinforcing learning.
[more details on the exam are provided in the regulation of KPT and the study program regulation].

Participation in industry visits is mandatory. The costs are covered from KPT. The lecturer initiates the procedure for a field visit by preparing the relevant document with the location, topics to be explored and expected learning outcomes (agenda) and the related costs. The document is subject of approval from the Head of Department. Students are questioned during the visit and back in class.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise, whereas 0 - 40 points indicate failure.

Points	Grade	In Letters
96-100	10	A
91-95	10	A-
86-90	9	B+
81-85	9	B
76-80	8	B-
71-75	8	C+
66-70	7	C
61-65	7	C-
56-60	6	D+
51-55	6	D
46-50	5	D-
41-45	5	E
0-40	4	F

Final Mark Allocation Criteria
10% - Participation and activation in exercises
30% - Laboratory/Practice
60% - Final exam

Bibliography	Mandatory: Textbook of lectures prepared by the course lecturer. Recommended: • "Energy Efficiency and Renewable Energy Handbook" by D. Yogi Goswami and Frank Kreith (2015) • "Energy Efficiency: Towards the End of Demand Growth" by Fereidoon P. Sioshansi (2013) • "Energy Efficient Buildings: Pathways to Zero-Energy" by Rüdiger Lohse and Bernd M. Buchholz (2017) • "Sustainable Energy - Without the Hot Air" by David J.C. MacKay (2009) Supplementary Materials: Other selected readings and case studies as may be provided case by case by the course lecturer.
Educational resources	During the course, lectures delivery will be accompanied with PowerPoint presentations, video simulations, and simulations with various software and real equipment. Exercises on the delivered lectures as well as a knowledge check through Teams platform or in class. Laboratories are conducted in smaller groups by working in team and /or alone with physical installations /workstations. The newly purchased desktops under the project will be used to run renewable energy SW for simulation, video etc., (lab 1, 2, 3, 5, 6 and 7). Licenses will be used in Lab 5, 6 and 7. 1 inverter and 400WA batteries for their use as energy storage system will be used as well. Case Studies: Review of case studies that will include group discussion on lessons learned and best practices Industry Visits: Site visits to industries and facilities for practical exposure.

Institution	Professional College of Tirana (KPT)
Module (Title)	**ENERGY AUDITING**
Full Name of the Professor	Msc. Enrik Skonja
Hours:	21 hours lecture - 24 exercises (seminars) - 21 labs
Program	- Course of a study program in VET degree (120 ECTS, 2 years) - Study program "Technology of Electrical Installations" - 6 ECTS / New module - Academic year 2024- 2025 - Teaching period: second semester of the second year of the study program - mandatory
Learning outcomes	**Knowledge and Understanding** By the end of this course, students will: • understand the principles of energy auditing. • understand how to conduct a comprehensive energy audit. • be able to analyze energy consumption in various systems. • have knowledge of identifying opportunities for energy conservation. • understand practical and cost-effective energy-saving measures. • have knowledge to prepare energy audit reports. **Capacity to apply Knowledge and Understanding**. The course will ensure that students will not only understand the theoretical aspects of energy auditing but also effectively apply their knowledge in practical, real-world settings to achieve tangible energy savings and improvements in efficiency. **Transversal Skills**. Transversal skills are essential for students in this energy auditing course, as they enhance students' ability to, work effectively with others, and adapt to the dynamic nature of the energy sector. • Ensure accuracy and thoroughness in data collection and analysis. • Ability to use diverse methods and tools of communication to communicate clearly and unambiguously technical information and findings through written reports and presentations with specialist and non-specialist audiences in national and international contexts. • Prioritize tasks and manage time efficiently to meet deadlines. • Stay up to date with evolving technologies and regulatory standards in energy management. • Adhere to ethical standards in data reporting and recommendations. • Maintain professionalism in interactions with clients and stakeholders/third parties. • Ability to function effectively as a valuable team member.

Content	Energy auditing is a vital field with growing importance in today's energy-conscious world, reflecting both the global and local significance of energy efficiency and sustainability. It is essential for promoting energy efficiency, reducing environmental impact, ensuring economic savings, and fostering professional growth. Therefore, the course is designed to prepare students to take informed decisions that benefit both the organization and society at large. **Topic 1 - Introduction to Energy Auditing** *(each topic is 1.5 hrs of lecture)* Overview of energy auditing. Importance of energy efficiency. The importance of energy efficiency lies in reducing energy consumption, lowering costs, and minimizing environmental impact. Types /methods of energy audits. Types of energy audits include preliminary audits (or walk-through audits), which provide a general overview, and detailed audits, which involve comprehensive data collection and analysis to identify specific energy-saving measures. **Topic 2 – Energy Audit process** Data Collection and data analysis for the audit. Steps in conducting an energy audit. Methods for data collection and data analyze. Conducting an energy audit involves several steps: planning, data collection, data analysis, and reporting. Methods for data collection include direct measurements, utility bill analysis, and using data loggers. **Topic 3 - Energy sources and energy conversion** Energy sources and energy conversion for all energy sources. Energy sources include fossil fuels (coal, oil, natural gas), renewable sources (solar, wind, hydro, biomass), and nuclear energy. Energy conversion refers to the process of transforming one form of energy into another, such as converting chemical energy in fuels into electrical energy in power plants. **Topic 4 - Environmental analysis** Environmental analysis, as an assessment of the environmental impact of energy use and identifies measures to reduce carbon footprint. This involves evaluating emissions, waste generation, and resource depletion associated with energy consumption **Topic 5 - Technical economic analysis** Technical economic analysis (cost-effectiveness of energy-saving measures). Its importance in prioritizing projects based on their economic viability and potential return on investment. **Topic 6 – Energy investments and their analyses** Analysis of energy investments (financial aspects of energy efficiency projects) **Topic 7 - Technologies used in residential buildings and their energy performance** Technologies for residential buildings and their energy performance characteristics including energy-efficient lighting, HVAC systems, insulation, windows, and renewable energy systems like solar panels **Topic 8 – Thermal Insulation of Buildings** Thermal insulation standards. Required levels of insulation for different building components to minimize heat loss or gain. Thermal Audit.

Topic 9 – Applicable energy efficient technologies
Energy technologies for buildings that improve energy efficiency (advanced HVAC systems, energy-efficient lighting, building automation systems, and renewable energy installations)

Topic 10 – Buildings' energy management
Buildings 'management from energy efficiency point of view.

Topic 11 Applicable legal frame
Legal and Bylaw Framework in force in Albania. Strategic Implementation Plans and Regulatory Aspects in Albania, with reference to the international commitments of Albania deriving from the international bodies Albania adheres to and specifically EU integration.

Topic 12 - Energy efficiency standards and regulations
National and EU energy efficiency standards and regulations in buildings. Practices and technologies to optimize energy use, that lead to substantial cost savings and reduced environmental impact.

Topic 13 - Energy performances of buildings
Energy performances of buildings (energy use intensity (EUI) and energy performance certificates (EPCs). New trends (smart buildings, integration of renewable energy, and advanced materials and technologies) that aim to enhance energy efficiency and sustainability in the built environment.

Topic 14 - Energy Audit Report
Technical-economic analysis of energy efficiency improvements in buildings, evaluating the feasibility, costs, and benefits of proposed measures. Energy Audit Report Preparation

Review and Final Exam
Review of key concepts. Course wrap-up. Final exam preparation..

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Lab work no. 1 - Health and safety in energy audit

Lab work no. 2 – Application of solar energy sources.

Lab work no. 3 – No load test on single phase induction motor and determination of equivalent circuit parameter.

Lab work no. 4 - Performance assessment of motors.

Lab work no. 5 - Performance assessment of lighting system.

Lab work no. 6 - Study of different illumination systems.

Lab work no. 7 - Conducting a mock energy audit. Preparing and presenting the audit report for a given building.

Methodology[6]	**Learning Evaluation Methods.** The examination procedure consists in 3 elements: (xiii) Participation and activation in exercises (xiv) Laboratory/Practice (xv) Final exam **Learning Evaluation Criteria**. The evaluation is done throughout the course for different elements: Regular attendance is required in line with the allowed absence limit provided however that active participation and participation in interactive lectures is required and is part of the element (i) of evaluation. *Participation and activation in exercises* classes, verify the student's knowledge and understanding of the given lectures. The lecturer through oral and /or written questions and exercises, or team work, assesses students understanding and knowledge of the delivered themes as well as triggers and encourages them to ask questions. *Participation and activation in Laboratory/Practice* verifies student's knowledge and understanding of the given lectures through practical tasks assigned to the students, whether individually or in group as the case may be; the student is assessed as well for the correct and accurate use of equipment in class, observation of health and safety rules and regulations while working; When case study are assigned, student's understanding of the case, the ability to analyze information, extract information, deduct from a larger pool of information to smaller clusters, and reach to a conclusion/finding are evaluated from the professor. For different lab works, students prepare a written document, namely Laboratory Report, that depicts all the steps undertaken by the student for a given Lab Topic, from the respective theory to its implementation in practice from the student. The Lab report is delivered to the lecturer for evaluation. The *final exam* is a crucial component of course evaluation, and along the two other elements, it serves as a comprehensive assessment of students' understanding and mastery of the course content. The final exam assesses the key concepts, skills, and knowledge outlined in the course's learning objectives. The distribution of questions reflects the emphasis placed on different topics throughout the course, ensuring that major areas are appropriately weighed. It uses a mix of question types (e.g., multiple-choice, short answer, essays, problem-solving) to assess different levels of learning, from basic recall to higher-order thinking and application. The exam includes a range of question difficulties, from basic to advanced, to accurately reflect the students' overall understanding and skills. The exam is designed by the lecturer and approved by the Head of the Department. Based on the provisions of KPT regulation and the regulation of the study program, the exam content remains secure before and during administration, and that it is only accessible to those authorized to take or administer the exam. Exams are usually written. Exams are conducted anonymously, being equipped with barcode until the assessment is done. The content of the exam ensures that all questions and instructions are clearly worded to avoid ambiguity, which can lead to confusion and misinterpretation. The exam is designed to be completed within the allotted time. The student's grading is

[6] Methodology is based on the provisions of the Regulation of KPT, Regulation of the study program "Technology of Electrical Installations" in KPT.

detailed for each question and is recorded on the exam paper, in ink, and on the student assessment summary table. Upon the exam, students are entitled to a review session where students can ask questions about the exam and understand the correct answers, further reinforcing learning.
[more details on the exam are provided in the regulation of KPT and the study program regulation].

Participation in industry visits is mandatory. The costs are covered from KPT. The lecturer initiates the procedure for a field visit by preparing the relevant document with the location, topics to be explored and expected learning outcomes (agenda) and the related costs. The document is subject to approval from the Head of Department. Students are questioned during the visit and back in class.

Learning Measurement Criteria.
A 100-points scale is used for grading, with possible praise, whereas 0 - 40 points indicates failure.

Points	Grade	In Letters
96-100	10	A
91-95	10	A-
86-90	9	B+
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76-80	8	B-
71-75	8	C+
66-70	7	C
61-65	7	C-
56-60	6	D+
51-55	6	D
46-50	5	D-
41-45	5	E
0-40	4	F

Final Mark Allocation Criteria
10% - Participation and activation in exercises
30% - Laboratory/Practice
60% - Final exam

Bibliography

Mandatory: Textbook of lectures prepared by the course lecturer.

Recommended:

- Turner, Wayne C., Doty S. Energy management handbook -- 6th ed. ISBN: 0-88173-542-6 (print) — 0-88173-543-4 (electronic) https://www.serviciilocale.md/public/files/Energy_Management_Handbook.pdf
- Palushi I, Vokshi M, Sistemet e ftohjes dhe impakti i tyre ne mjedis, Tirane 2017
- Andujar J.M., Melgar S.G., Eenrgy Efficiency: Concepts and Calculations, Elsevier, London, 2019

Supplementary Materials: Selected readings and case studies that may be provided by the course lecturer.

Educational resources	During the course, lectures delivery will be accompanied with PowerPoint presentations, video simulations, and simulations with various software and real equipment. The lectures aim to be interactive to trigger their attention. Laboratories are conducted in smaller groups by working in team and /or alone with physical installations /workstations. The new purchased desktops under the project will be used to run SW for simulation, video etc., while a special importance for the delivery of lab and seminars will have the full set of laboratory equipment purchased under the project to perform energy audit (Hygro Anemometer, Thermo Hygrometer etc.). Tools such as: Access to energy auditing software and measuring instruments: Battery Capacity Tester 1200 AH 6V-60V Ground Resistance Tester Insulation Resistance Tester 5kV Leakage Current Tester Digital A/C Multi-function Calibrator Clamp Meter Digital Multi-meter Digital Precision Multi-meter Hygrometer Phase Sequence Indicator Thermo Hygrometer Fluke Make Advanced Power Quality and Energy Analyzer Power Quality Analyzer Equinox Digital Vibration Meter etc. The devices to be purchased such as such as thermocouples, thermo hygrometer, anemometer, Thermal Imaging Camera, Pressure Sensors, Light Detectors serve quite well for Topic number 5, 9 & 10 as well as in the last topic to make a final report. 2 Licenses for HVAC and renewable energy technologies simulation will be used in Topic 10 & 13 1 inverter and 400WA batteries for their use as energy storage system for Topic 10 & 13. Industry Visits: Site visits to industries and facilities for practical exposure. Case Studies: Review of real-world energy audits, that will include group discussion on lessons learned and best practices

Annex 4: Universum International College (UC)

MODULE: UNDERSTANDING ENERGY RESOURCES AND CONSUMPTION

Institution	UNI - Universum International College
Module (Title)	**UNDERSTANDING ENERGY RESOURCES AND CONSUMPTION**
Full Name of the Professor	
Hours:	Lectures: 24 hours, practice: 24 lab hours, independent student's work: 102 learning hours Total: 150 hr.
Program	• Degree: BA • Study program: Business and Management • Academic year & semester: 2nd year – 4th semester • No. of ECTS: 6 ECTS (150 hr)/New Module • Mandatory • Starting during the academic year: 2024/2025
Learning Outcomes	The Understanding Energy Resources and Consumption program offers a comprehensive exploration of the energy industry. Students will develop a strong foundation in energy economics, policy, and technology, preparing them for careers in energy management, policy, and consulting. Through a blend of theoretical knowledge and practical application, students will analyze energy markets, evaluate renewable energy options, and understand the complexities of energy risk management. The program emphasizes critical thinking, problem-solving, and decision-making skills to address the challenges and opportunities presented by the global energy transition. Upon completion of this course, students will be able to: **Knowledge and understanding** • Demonstrate a comprehensive understanding of the global energy landscape, including resources, consumption patterns, and market dynamics. • Critically analyse energy policies and regulations and their impacts on economic, environmental, and social outcomes. **Capacity to apply knowledge and understanding** • Apply energy management principles and tools to optimize energy efficiency, conservation, and performance. • Evaluate the technical, economic, and environmental feasibility of renewable energy technologies and systems. • Assess and manage energy-related risks and uncertainties in business operations.

	• Develop and implement sustainable energy strategies for organizations. • Develop informed perspectives and strategies to address Kosovo's specific energy challenges using renewable energy solutions. **Transversal skills** • Enhance their ability to communicate complex energy concepts and data clearly and persuasively to diverse audiences, including stakeholders and policymakers. • Improve their teamwork skills by collaborating on projects, sharing insights, and integrating different perspectives to develop comprehensive solutions for energy sustainability challenges.
Content	**<u>Topic 1: Course Introduction</u>** 2 hr lect, 2hr lab, 4 hr independent work **Lecture Description** In this introductory lecture, students will receive an overview of the course objectives, structure, and key topics to be covered. They will gain an understanding of the importance of studying energy resources and consumption in the context of business management. Additionally, students will be introduced to basic energy concepts and terminology, setting the foundation for more in-depth exploration in subsequent lectures. This session aims to equip students with a clear roadmap for the course and to spark their interest in the critical issues surrounding energy management and sustainability. **Labs:** • Students will collaboratively build a visual map of key terms and ideas. **<u>Topic 2: Energy in Our Minds: Concepts and Measures</u>** 2 hr lect, 2 hr lab, 8 hr independent work **Lecture Description:** In this lecture, students will be introduced to the fundamental concepts of energy, covering the various types such as kinetic, potential, thermal, chemical, and electrical energy, as well as the primary sources including fossil fuels, nuclear power, and renewable resources like solar, wind, and hydroelectric power. They will explore different methods for measuring and quantifying energy consumption, learning to apply key metrics and tools in practical scenarios. **Labs:** **Methodology:** • Students will analyze case studies to see practical uses of energy concepts. • Students will engage in a hands-on activity to measure and analyze energy data. **<u>Topic 3: Energy in the Modern World: Fossil Fueled Civilization</u>** 2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will explore the historical and contemporary role of fossil fuels in shaping modern civilization, understanding how they have driven economic development and industrialization. They will examine the environmental and social consequences of a fossil-fueled society, considering issues such as pollution, climate change, and social inequalities. The lecture will also analyze current trends and challenges related to fossil fuel dependency, highlighting the complexities and implications of transitioning to more sustainable energy sources.

Labs:

Methodology:

- Students will engage with multimedia presentations to explore the history and impact of fossil fuels.
- Students will analyze case studies that illustrate the role of fossil fuels in modern industry and society.
- Students will engage in a group activity to evaluate current trends and challenges in fossil fuel

Topic 4: Energy Resources

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will gain a thorough understanding of different types of energy resources, encompassing both renewable and non-renewable sources. They will learn about the processes involved in the extraction, production, and distribution of various energy resources, examining the technical and logistical aspects. The lecture will explore the advantages and disadvantages of each type of energy resource, considering factors such as efficiency, cost, environmental impact, and sustainability. Additionally, students will analyze the global distribution of energy resources and the geopolitical implications, understanding how energy availability influences international relations and economic stability.

Labs:

- Students will analyze case studies highlighting the benefits and challenges associated with various energy resources.
- Students will collaborate in a group activity to examine the global distribution of energy resources and their geopolitical impacts.

Software: OpenStudio and Energy3D

Topic 5: The Economics of Energy

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will delve into the fundamental economic principles that govern energy markets, gaining insights into supply and demand, pricing mechanisms, and market structures. They will learn about the various factors that influence energy prices and market dynamics, such as production costs, geopolitical

events, and technological advancements. The lecture will explore the economic impact of energy consumption on businesses and broader economies, highlighting both the costs and benefits. Additionally, students will analyze the role of government policies and regulations in shaping energy markets, understanding how interventions like subsidies, taxes, and environmental regulations affect market behavior and energy strategies.

Labs:

- Students will engage in project-based learning to learn about economic principles and factors affecting energy markets.
- Students will analyze case studies to understand the economic impact of energy consumption.
- Students will explore the role of government policies through a group activity evaluating different regulatory approaches.

Software: HOMER Energy

Topic 6: Energy, Markets and Society

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will explore the intricate relationship between energy markets and societal impacts, understanding how fluctuations in energy markets can affect social and economic stability. They will delve into the social implications of energy consumption and resource distribution, examining issues such as energy access, affordability, and equity. The lecture will also include an analysis of case studies to illustrate the broader societal consequences of energy policies and market changes, providing students with real-world examples of how energy decisions can influence communities and economies.

Labs:

- Students will engage in project-based learning to explore the relationship between energy markets and societal impacts.
- Students will analyze case studies to examine the social implications of energy consumption and resource distribution.
- Students will collaborate in a group activity to evaluate the broader societal consequences of energy policies and market changes.

Software: HOMER Energy and OpenStudio

Topic 7: CO2 Global Trade

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will examine the global carbon trading market, focusing on how CO2 trading systems are used to mitigate climate change. They will gain an understanding of different carbon trading mechanisms, such as cap-and-trade and carbon offset programs, and their roles in reducing global greenhouse gas emissions. The discussion will cover the economic and environmental impacts of these systems,

including their effectiveness in promoting sustainable practices and influencing international climate policy.

Labs:

- Students will engage in project-based learning to explore various carbon trading mechanisms and their global impact.
- Students will analyze case studies to understand the economic and environmental outcomes of carbon trading.
- Students will collaborate in a group activity to evaluate recent trends and policy implications in CO2 global trade.

Software: HOMER Energy and OpenStudio

Topic 8: Economic Implications of Conventional Energy Sources

2 hr lect, 2hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will explore further the types and characteristics of conventional energy sources, including coal, oil, and natural gas. They will learn in depth about the economic implications of using these sources, focusing on cost factors, market dynamics, and the broader economic impacts. The lecture will also address the environmental and social impacts associated with conventional energy use, examining issues such as pollution, health risks, and social equity. Additionally, students will analyze the role of conventional energy sources in both current and future energy markets, considering their continuing relevance and potential shifts in energy demand.

Labs:

- Students will engage with interactive presentations to learn about different conventional energy sources and their economic characteristics.
- Students will analyze case studies to examine the environmental and social impacts of conventional energy use.
- Students will collaborate in a group activity to evaluate the role of conventional energy sources in current and future energy markets.

Software: OpenStudio

Topic 9: Economic Implications of Alternative Energy Sources

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into various alternative energy sources, including solar, wind, and bioenergy. They will learn in depth about the economic factors that influence the adoption and viability of these alternative sources, such as investment costs, technological advancements, and market incentives. The lecture will include a cost-benefit analysis comparing alternative energy sources to conventional ones, highlighting their economic advantages and challenges. Additionally, students will analyze the impact of alternative energy sources on energy markets and economic

development, considering how they contribute to sustainability and reshape energy landscapes.

Labs:

- Students will engage with interactive presentations to understand different alternative energy sources and their economic aspects.
- Students will analyze case studies to evaluate the economic impact of alternative energy sources.
- Students will collaborate in a group activity to assess the role of alternative energy in shaping future energy markets and economic development.

Software: OpenStudio, Energy3D, and HOMER Energy

Topic 10: Energy Security

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will gain a comprehensive understanding of the concept of energy security and its significance for both national and global stability. They will learn about the various factors that influence energy security, including geopolitical tensions, economic conditions, and environmental concerns. The lecture will explore strategies and policies designed to enhance energy security and manage associated risks, such as diversification of energy sources, strategic reserves, and international cooperation. Students will analyze case studies to evaluate real-world challenges and solutions related to energy security, providing insights into how different regions and nations address and mitigate energy-related vulnerabilities.

Labs:

- Students will engage with interactive presentations and current data to grasp the concept and importance of energy security.
- Students will analyze case studies to understand various strategies and policies for enhancing energy security.
- Students will collaborate in a group activity to develop and evaluate strategies for managing energy security risks and challenges.

Software: HOMER Energy and OpenStudio

Topic 11: Energy Sustainability

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description

In this lecture, students will explore the principles and goals of energy sustainability, focusing on the importance of meeting current energy needs without compromising the ability of future generations to meet their own needs. They will learn about various sustainable energy technologies and practices, including energy efficiency measures, renewable energy systems, and sustainable consumption patterns. The lecture will highlight the environmental, economic, and social benefits of adopting sustainable energy solutions, such as reduced carbon emissions, economic growth, and improved quality of life. Students will also analyze the challenges and strategies

	associated with achieving long-term energy sustainability, addressing issues such as policy development, technological innovation, and societal acceptance. **Labs:** • Students will analyze case studies to explore the benefits and challenges of sustainable energy solutions. • Students will collaborate in a group activity to develop strategies for overcoming obstacles and promoting long-term energy sustainability. **Software:** OpenStudio, Energy3D, and HOMER Energy **Topic 12: The Future of Energy** 2 hr lect, 2 hr lab, 9 hr independent work **Lecture Description:** In this lecture, students will explore emerging trends and technologies in the energy sector, including advancements in renewable energy, energy storage, and smart grid technologies. They will consider potential future scenarios for energy production and consumption, evaluating how these scenarios could shape the global energy landscape. The lecture will analyze the implications of innovative energy solutions for businesses and societies, focusing on how these developments can drive economic growth, environmental sustainability, and social progress. Additionally, students will discuss strategies for transitioning to a sustainable energy future, considering policy measures, technological innovations, and collaborative efforts necessary to achieve long-term energy goals **Labs:** • Students will collaborate in a group activity to develop strategies for transitioning to a sustainable energy future. • Students will collaborate and analyse real-life scenarios in regards to the future of energy challenges. **Course Project Due**
Methodology	**Learning Evaluation Methods** Learning Evaluation Methods for this course includes summative assessments to measure students' understanding and practical application of energy management principles. The summative assessment, totalling 100 points, includes three components: • The ASU Initiative which requires students to complete a relevant certification from Arizona State University, reinforcing foundational knowledge. • Open-ended questions and mini-case studies which test students' critical thinking and analytical skills on energy management scenarios. • The main project, Energy Efficiency Analysis for a Commercial Building. Students would perform an energy audit, identify inefficiencies, and propose strategies for energy optimization, such as improving insulation, installing energy-efficient lighting, and integrating renewable energy sources.

Learning Evaluation Criteria

- Arizona State University (ASU) certification:
  - Demonstrate proficiency in sustainability and energy management
- Open Ended Questions and Minicases:
  - Clarity and accuracy of answers
  - Application of key concepts and principles
  - Logical reasoning, critical thinking and problem-solving skills
  - Completeness of responses
  - Ability to analyze case studies or scenarios
- Main Project Evaluation Criteria:
  - Relevance and depth of research or analysis
  - Practical application of course concepts
  - Quality and feasibility of proposed solutions or strategies
  - Clarity of presentation (written or oral)
  - Team collaboration and contribution

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Evaluation rate	Grade description	Grading letters
90 % - 100 %	Excellent	A
80 % - 89 %	Very good	B
70 % - 79 %	Good	C
60 % - 69 %	Satisfactory	D
45 % - 59 %	Sufficient	E
44 % - 0	Fail	F

Final Mark Allocation Criteria.

1	Summative Assesment	Points
1.1	ASU Initiative	20
1.2	Open Ended Questions and Minicases.	35
1.3	Project: Energy Efficiency Analysis for a Commercial Building	45
	Total of Summative Assesment	**100**

Bibliography	*Recommended Textbooks:* Smil, V. (2017). Energy: A Beginner's Guide. Oneworld Publications. Webber, M. E. (2019). Power Trip: The Story of Energy. Basic Books. Schwarz, P. M. (2022). Energy Economics (2nd ed.). Routledge.
Educational Resources	Required resources include access to computers and the internet for research, software for energy analysis (HOMER Energy), projectors for lectures, and a smart board for video presentations. Facilities for virtual or in-person field visits to energy sites and guest lectures are also essential. Therefore, utilizing the whiteboards' advanced conferencing features (acquired with the reZEB budget) for possible virtual sessions in the field of energy resources from around the globe will provide students with diverse perspectives and real-world insights into energy consumption and management strategies. In addition to this, OpenStudio and Energy3D for analyzing green buildings and renewable energy systems will also be utilized.

Institution	UNI - Universum International College
Module (Title)	**LIFE CYCLE MANAGEMENT**
Full Name of the Professor	
Hours:	Lectures: 24 hours practice: 24 lab hours, independent student's work: 102 learning hours Total: 150 hr.
Program	• Degree: BA • Study program: Business and Management • Academic year & semester: 2nd year – 4th semester • No. of ECTS: 6 ECTS (150 hr) / New Module • Mandatory • Starting during the academic year: 2024/2025
Learning Outcomes	The Life Cycle Management course at UNI - Universum International College is designed to equip students with a thorough understanding of the life cycle approach in managing products, processes, and services. This course delves into the environmental and economic aspects of product life cycles, from raw material extraction to end-of-life disposal. By exploring life cycle assessment (LCA) methodologies and sustainability strategies, students will learn to minimize environmental impacts, optimize resource use, and enhance product sustainability throughout its life cycle. The course emphasizes practical applications in various industries, helping students to integrate life cycle thinking into decision-making processes. Upon completion of this course, students will be able to: **Knowledge and understanding** Understand the key concepts and principles of life cycle management and their relevance in sustainable product and process management. • Conduct life cycle assessments (LCA) to evaluate the environmental impacts of products and services across different stages of their life cycle. **Capacity to apply knowledge and understanding** Identify and analyze opportunities for reducing resource consumption and minimizing waste throughout the life cycle of products. • Develop strategies for improving the sustainability of products and services, considering environmental, economic, and social factors.

	• Apply life cycle thinking to decision-making processes in various industries, ensuring long-term sustainability and resource efficiency. **Transversal skills** • Communicate life cycle management strategies and their implications effectively to stakeholders, including industry professionals and policymakers.
Content	**<u>Topic 1: Course Introduction</u>** 2 hr lect, 2 hr lab, 9 hr independent work **Lecture Description:** In this lecture, students will delve into the fundamental concepts of sustainable economic development. The session will cover the definitions and principles of sustainability, the triple bottom line (economic, environmental, and social factors), and the importance of integrating sustainability into economic planning and policy. Students will explore various sustainable development goals (SDGs) and their relevance to different sectors of the economy. This lecture aims to provide students with a solid foundation in understanding the key components of sustainable economic development and how these principles can be applied to foster long-term economic growth that is environmentally and socially responsible. **Labs:** • Students will analyze real-world case studies from different industries (e.g., manufacturing, energy, consumer goods) to evaluate how Life Cycle Management is applied and its impact on sustainability. • Students will be divided into small groups, with each group focusing on a specific stage of the product life cycle (e.g., raw material extraction, production, distribution, end-of-life disposal) • Students will collaboratively create a visual map that links the stages of the life cycle with the principles of Life Cycle Management. **<u>Topic 2: Introduction to Life Cycle Management</u>** 2 hr lect, 2 hr lab, 9 hr independent work **Lecture Description:** In this lecture, students will be introduced to the fundamental concepts of Life Cycle Management (LCM), including its definitions, scope, and importance in sustainable product and process management. The session will cover the life cycle approach, emphasizing the cradle-to-grave perspective that considers all stages of a product's life, from raw material extraction to disposal. Students will learn about the role of Life Cycle Assessment (LCA) as a tool to evaluate the environmental impacts associated with each stage of the life cycle. This lecture aims to provide students with a foundational understanding of Life Cycle Management and its significance in promoting sustainability across various industries. **Labs:** • Students will analyze the different stages of the product life cycle and how Life Cycle Assessment (LCA) is used to measure the environmental impacts associated with each stage.

- Students will work in groups to identify and discuss the key components of Life Cycle Management, such as resource efficiency, waste minimization, and environmental impact reduction.
- Students will collaboratively create a visual map that illustrates the stages of the product life cycle, highlighting the opportunities for integrating sustainability practices at each stage.

Topic 3: LCM and Sustainability

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture focuses on the practical application of Life Cycle Management (LCM) principles in business practices to achieve sustainability goals. Students will explore how businesses can integrate life cycle thinking into their operations, from product design and manufacturing to marketing and disposal. The session will cover strategies for minimizing environmental impacts, optimizing resource use, and enhancing product sustainability throughout its life cycle. Case studies from various industries will be examined to illustrate successful implementation of LCM in business, highlighting both challenges and best practices. The lecture aims to equip students with the knowledge and tools to apply LCM in real-world business scenarios, driving sustainable innovation and competitiveness.

Labs:

- Students will analyze case studies of companies that have successfully implemented LCM to improve their sustainability performance, identifying key strategies and outcomes.
- Students will work in groups to develop a sustainability strategy for a hypothetical business, incorporating LCM principles
- Students will collaboratively create a presentation that outlines their proposed sustainability strategy, focusing on how LCM can be used to achieve long-term business success while minimizing environmental impacts.

Topic 4: Life Cycle Management in Business

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture delves into the integration of Life Cycle Management (LCM) within business operations and strategies. Students will explore how businesses can adopt LCM to improve efficiency, reduce environmental impacts, and enhance sustainability. The session will cover the practical aspects of applying LCM in various business functions such as product development, supply chain management, and marketing. Students will also learn about the benefits and challenges of implementing LCM, including cost considerations, regulatory compliance, and stakeholder engagement. By examining real-world examples, this lecture aims to provide students with a comprehensive understanding of how businesses can leverage LCM to create value while promoting sustainability.

Labs:

- Students will analyze real-world examples of companies that have successfully integrated LCM into their business models, focusing on the strategies used and the outcomes achieved.
- Students will work in groups to identify and propose LCM practices that can be implemented in specific business functions such as product development, supply chain management, or marketing.
- Students will collaboratively create a business case that outlines the benefits and potential challenges of adopting LCM in a chosen industry.

Software: EcoWin

Topic 5: Sustainable Value Creation with Life Cycle Management

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture focuses on how Life Cycle Management (LCM) can be used to create sustainable value in business practices. Students will explore how integrating LCM can lead to innovations that not only improve environmental performance but also generate economic and social value. The session will cover strategies for using LCM to enhance product design, optimize resource use, and create competitive advantages. Topics will include the development of sustainable business models, value chain optimization, and the role of stakeholder engagement in driving sustainable value. By examining case studies and industry best practices, this lecture aims to provide students with insights into leveraging LCM for creating long-term, sustainable value in various business contexts.

Labs:

- Students will analyze case studies of companies that have successfully created sustainable value through the application of LCM, focusing on the innovations and strategies employed.
- Students will work in groups to develop a plan for incorporating LCM into a business model to enhance sustainability and create value.
- Students will collaboratively create a presentation that outlines their proposed sustainable value creation plan.

Software: OpenLCA, R and JASP

Topic 6: Sustainable Production and Sustainable Consumption

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture on Sustainable Production and Sustainable Consumption will examine how integrating sustainability principles throughout production and consumption processes can enhance both environmental and business performance. Students will explore strategies to minimize resource use, reduce waste, and adopt more responsible consumption patterns that align with circular economy principles. The session will cover key topics such as sustainable product design, energy efficiency in production, supply chain optimization, and the promotion of sustainable consumer behavior. By studying real-world examples and industry innovations, students will gain insights

into how sustainable production and consumption practices can create competitive advantages, foster innovation, and contribute to long-term business success while minimizing environmental impact.

Labs:

- Students will analyze case studies of businesses that have successfully implemented sustainable production practices and promoted sustainable consumption, identifying key strategies and outcomes.
- Students will work in groups to develop a comprehensive plan that addresses both sustainable production and consumption for a specific product or service.
- Students will collaboratively create a visual representation that maps the flow from sustainable production to sustainable consumption, highlighting opportunities for improving sustainability throughout the product lifecycle.

Software: QGIS and OpenLCA

Topic 7: Life Cycle Management Mainstream: Integration in Corporate Finance and Accounting

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture addresses the integration of Life Cycle Management (LCM) into corporate finance and accounting practices. Students will explore how LCM principles can be embedded into financial decision-making and accounting systems to support sustainable business practices. The session will cover topics such as the incorporation of life cycle costs into financial analysis, the impact of sustainability on financial reporting, and the role of accounting in tracking and managing life cycle impacts. Students will examine case studies of companies that have integrated LCM into their financial and accounting practices, highlighting the benefits and challenges of this integration. This lecture aims to provide students with a comprehensive understanding of how LCM can be mainstreamed into corporate finance and accounting to drive sustainability and financial performance.

Labs:

- Students will analyze case studies of companies that have successfully incorporated life cycle costs and sustainability metrics into their financial and accounting systems, identifying key strategies and outcomes.
- Students will work in groups to develop a financial model that includes life cycle costs for a specific product or service.
- Students will collaboratively create a presentation that outlines their financial model, discussing how integrating LCM into corporate finance and accounting can enhance sustainability and financial performance.

Software: GNU Cash and Google Sheet

Topic 8: The Role of LCM in Industry

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture emphasizes the critical role of communication and collaboration in mainstreaming Life Cycle Management (LCM) within organizations and across industries. Students will explore strategies for effectively communicating the benefits and importance of LCM to stakeholders, including management, employees, customers, and suppliers. The session will cover methods for fostering collaboration both within organizations and between different stakeholders to support the successful implementation of LCM practices. Students will examine case studies highlighting successful communication and collaboration efforts in LCM, and discuss best practices for overcoming common barriers.

Labs:

- Students will analyze case studies of organizations that have effectively used communication and collaboration to mainstream LCM.
- Students will work in groups to develop a communication and collaboration plan for implementing LCM in a hypothetical organization, addressing how to engage different stakeholders and overcome potential challenges.
- Students will collaboratively create a presentation that outlines their plan, including strategies for effective communication and collaboration.

Software: Inkscape, GIMP and Google Sheets.

Topic 9: LCA in the Context of Energy and Transport Systems

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture explores the application of Life Cycle Assessment (LCA) within the context of energy and transport systems. Students will learn how LCA can be used to evaluate the environmental impacts of various energy sources and transportation modes throughout their life cycles. The session will cover methodologies for assessing the sustainability of energy production, distribution, and consumption, as well as the environmental impacts of different transport systems. Case studies will illustrate the use of LCA in optimizing energy and transport systems for improved sustainability. The lecture aims to provide students with a comprehensive understanding of how LCA can inform decisions in energy and transport sectors to support sustainable development.

Lab

- Students will analyze case studies of energy and transport systems where LCA has been used to assess environmental impacts and identify opportunities for improvement.
- Students will work in groups to perform a simplified LCA of a specific energy source or transport system.
- Students will collaboratively create a report that presents their findings, including recommendations for enhancing the sustainability of the chosen energy or transport system based on their LCA.

Software: OpenLCA, MATLAB and R.

Topic 10: The Importance of LCA in Environmental Impact Assessment

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture focuses on the critical role of Life Cycle Assessment (LCA) in Environmental Impact Assessment (EIA). Students will explore how LCA can enhance the effectiveness of EIA by providing a comprehensive evaluation of the environmental impacts of projects and products across their entire life cycle. The session will cover the integration of LCA into the EIA process, including methodologies for assessing life cycle impacts, identifying key environmental aspects, and making informed decisions based on LCA results. Case studies will illustrate successful applications of LCA in EIA and highlight best practices and challenges. The lecture aims to provide students with an understanding of how LCA can contribute to more robust and comprehensive environmental assessments.

Labs:

- Students will analyze case studies where LCA has been integrated into the EIA process.
- Students will work in groups to develop an LCA-based approach for a hypothetical EIA project, considering factors such as impact identification, data collection, and result interpretation.
  Students will collaboratively create a presentation that outlines their LCA-based approach for the EIA project.

Software: OpenLCA, MATLAB and R.

Topic 11: Exploring Challenges and Opportunities of Life Cycle Management in the Electricity Sector

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

This lecture examines the application of Life Cycle Management (LCM) in the electricity sector, focusing on the unique challenges and opportunities associated with this industry. Students will explore how LCM can be used to assess and improve the sustainability of electricity generation, distribution, and consumption. The session will cover the environmental impacts of various energy sources, including fossil fuels, nuclear, and renewables, and the role of LCM in mitigating these impacts. Students will also discuss strategies for integrating LCM into energy policy and business practices to enhance sustainability. Case studies from the electricity sector will provide insights into successful LCM implementations and highlight areas for further development.

Labs:

- Students will analyze case studies of electricity providers that have implemented LCM to improve sustainability, focusing on the strategies used and the outcomes achieved.
- Students will work in groups to develop a life cycle management plan for a specific electricity generation method or infrastructure.

	• Students will collaboratively create a report that presents their life cycle management plan, including recommendations for enhancing the sustainability of the electricity sector based on their findings. Software: OpenLCA, MATLAB and EnergyPlus. **<u>Topic 12: Life Cycle Management in the Food and Beverage Industry</u>** 2 hr lect, 2 hr lab, 9 hr independent work **Lecture Description:** This lecture focuses on the application of Life Cycle Management (LCM) within the food and beverage industry, highlighting the sector's unique challenges and opportunities. Students will explore how LCM can be used to assess and enhance the sustainability of food and beverage products throughout their life cycles, from raw material sourcing to production, distribution, consumption, and disposal. The session will cover methodologies for evaluating environmental impacts, such as resource use, waste generation, and carbon footprint, and discuss strategies for improving sustainability in this industry. Case studies will illustrate successful LCM applications and best practices in the food and beverage sector. **Labs:** • Students will analyze case studies of food and beverage companies that have successfully implemented LCM • Students will work in groups to develop an LCM plan for a specific food or beverage product, considering aspects such as resource efficiency, waste reduction, and environmental impact mitigation. • Students will collaboratively create a presentation that outlines their LCM plan, including recommendations for enhancing the sustainability of the chosen product and discussing the potential benefits and challenges of implementation. Software: OpenLCA, Google Sheets and LibreOffice Calc.
Methodology	**Learning Evaluation Methods** Learning Evaluation Methods for this course utilize both summative assessments to comprehensively gauge students' understanding and application of life cycle management principles. This approach ensures a thorough evaluation of students' theoretical knowledge, analytical skills, and ability to apply learned concepts to real-world scenarios. The summative assessment, totalling 100 points, includes three components: • The ASU Initiative which involves students completing a module or certification provided by Arizona State University related to life cycle management or sustainable practices. This element reinforces foundational concepts and validates students' understanding. • Open-ended questions and mini-case studies which challenge students to apply theoretical knowledge to specific scenarios. This part of the assessment evaluates students' analytical skills, their ability to think critically about life cycle

management principles, and their proficiency in discussing complex sustainability issues.

- The main project. It requires students to perform an in-depth Life Cycle Assessment (LCA) of a consumer product, such as a smartphone or beverage bottle. Students analyze the environmental impacts of the product across all stages—from raw material extraction to disposal—while identifying and proposing opportunities for improvements in resource efficiency, waste minimization, and overall sustainability.

Learning Evaluation Criteria

- Arizona State University (ASU) certification:
  - Demonstrate proficiency in life cycle management or sustainable practices
- Open Ended Questions and Minicases:
  - Clarity and accuracy of answers
  - Application of key concepts and principles
  - Logical reasoning, critical thinking and problem-solving skills
  - Completeness of responses
  - Ability to analyze case studies or scenarios
- Main Project Evaluation Criteria:
  Points are awarded based on the thoroughness of their analysis, accuracy in identifying impacts, and creativity in the proposed solutions for sustainability. The following aspects are evaluated:
  - Relevance and depth of research or analysis
  - Practical application of course concepts
  - Quality and feasibility of proposed solutions or strategies
  - Clarity of presentation (written or oral)
  - Team collaboration and contribution

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Evaluation rate	Grade description	Grading letters
90 % - 100 %	Excellent	A
80 % - 89 %	Very good	B
70 % - 79 %	Good	C
60 % - 69 %	Satisfactory	D
45 % - 59 %	Sufficient	E
44 % - 0	Fail	F

Final Mark Allocation Criteria.

1	Summative Assesment	Points
1.1	ASU Initiative	20
1.2	Open Ended Questions and Minicases.	35
1.3	Project: Life Cycle Assessment (LCA) for a Consumer Product	45
	Total of Summative Assesment	**100**

Bibliography

Recommended Textbooks:

Sonnemann, G., & Margni, M. (Eds.). (2015). *Life Cycle Management*. Springer.

Klos, Z. S. (Ed.), Kalkowska, J. (Ed.), & Kasprzak, J. (Ed.). (2021). *Towards a Sustainable Future: Life Cycle Management: Challenges and Prospects.* Springer.

Educational Resources

Required resources include access to computers and whiteboards (equipment acquired with the reZEB budget) for running the software for LCA analysis and for video presentations, and projectors for lectures. Facilities for virtual or in-person field visits to energy sites and guest lectures are also essential.

Integrating simulations related to Life Cycle Management (LCM) into the curriculum will offer practical learning experiences tailored to the needs of the course. OpenLCA will be used for LCA analysis. To support students in managing sustainability-related data, a variety of free and open-source technologies will be employed. For statistical analysis and data visualization, R and JASP will be used, and QGIS will support geographic information system (GIS) analysis. Additional tools such as Orange for data mining and machine learning, EcoWin for environmental and economic modeling, and Inkscape and GIMP for creating and editing visuals will also be employed. These technologies will help students effectively budget, perform financial analyses, and manage data throughout the life cycle of products and processes, enhancing their understanding of LCM in real-world applications.

Institution	UNI - Universum International College
Module (Title)	**SUSTAINABLE ECONOMIC DEVELOPMENT**
Full Name of the Professor	
Hours:	Lectures: 24 hours, practice: 24 lab hours, independent student's work: 102 learning hours Total: 150 hr.
Program	• Degree: BA • Study program: Business and Management • Academic year & semester: 3rd year – 6th semester • No. of ECTS: 6 ECTS (150 hr) • Mandatory • Starting during the academic year: 2024/2025
Learning Outcomes	The Sustainable Economic Development course at UNI - Universum International College has been designed to provide students with a comprehensive understanding of economic principles and their applications in promoting sustainability. This course explores the intersection of economic development and environmental sustainability, emphasizing the importance of integrating green technologies and sustainable practices into economic planning and policy. By focusing on sustainable development strategies, students will learn to address the challenges of economic growth while ensuring environmental protection and social equity. Upon successful completion of this course, students will be able to: **Knowledge and understanding** • Understand the fundamental concepts of sustainable economic development and their significance in contemporary economic planning. • Analyze the relationship between economic growth, environmental sustainability, and social equity, identifying strategies to balance these elements in development policies. **Capacity to apply knowledge and understanding** • Evaluate the economic impacts of implementing green technologies and sustainable practices in various sectors, including energy, transportation, urban planning, buildings and agriculture. • Develop and apply economic models to assess the feasibility and effectiveness of sustainable development initiatives.

	Transversal skills • Apply critical thinking and problem-solving skills to address complex issues related to sustainable economic development. • Effectively communicate sustainable development strategies and their economic implications to diverse audiences.
Content	**<u>Topic 1: Course Introduction</u>** 2 hr lect, 2 hr lab, 4 hr independent work **Lecture Description** In this lecture, students will delve into the fundamental concepts of sustainable economic development. The session will cover the definitions and principles of sustainability, the triple bottom line (economic, environmental, and social factors), and the importance of integrating sustainability into economic planning and policy. Students will explore various sustainable development goals (SDGs) and their relevance to different sectors of the economy. This lecture aims to provide students with a solid foundation in understanding the key components of sustainable economic development and how these principles can be applied to foster long-term economic growth that is environmentally and socially responsible. **Labs:** • Students will analyze real-world examples of sustainable development initiatives from various sectors (e.g., energy, agriculture, transportation) to understand their impact and effectiveness. • Students will be divided into small groups to identify and present on one of the Sustainable Development Goals (SDGs), discussing its importance, challenges, and potential strategies for implementation. • Students will collaboratively create a visual map that connects the principles of sustainable economic development with the SDGs, highlighting the interdependencies and potential synergies. **<u>Topic 2: Introduction to Economic Growth</u>** 2 hr lect, 2 hr lab, 8 hr independent work **Lecture Description** In this lecture, students will be introduced to the concept of economic growth, including its definitions, measurements, and significance in economic development. The session will explore various indicators of economic growth such as GDP, GNP, and per capita income, and will discuss the factors that drive economic growth, including technology, capital, labor, and policy. Students will also examine the implications of economic growth on society and the environment, considering both positive and negative impacts. This lecture aims to provide students with a foundational understanding of economic growth and its role in shaping sustainable development strategies. **Labs:** • Students will analyze different indicators of economic growth and how they are measured, including GDP, GNP, and per capita income.

- Students will work in groups to identify and discuss the key drivers of economic growth, such as technology, capital, labor, and policy.
- Students will collaboratively create a visual map that illustrates the positive and negative impacts of economic growth on society and the environment, identifying ways to balance growth with sustainability.

Topic 3: Introduction to Population Growth

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description

In this lecture, students will explore the concept of population growth, including its definitions, measurements, and significance in economic and sustainable development. The session will cover key demographic indicators such as birth rate, death rate, and population density, and will discuss the factors influencing population growth, such as healthcare, education, and economic opportunities. Students will examine the impact of population growth on resources, environment, and social structures, as well as the challenges and opportunities it presents for sustainable development. This lecture aims to provide students with a comprehensive understanding of population growth dynamics and their implications for economic and sustainable development strategies.

Labs:

- Students will analyze demographic indicators such as birth rate, death rate, and population density, and how they are measured.
- Students will work in groups to identify and discuss the factors influencing population growth, such as healthcare, education, and economic opportunities.
- Students will collaboratively create a visual map that illustrates the impacts of population growth on resources, the environment, and social structures, and identify potential strategies to manage these impacts in a sustainable manner.

Topic 4: Classic Theories of Economic Growth

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will be introduced to classic theories of economic growth that have shaped economic thought and policy over the years. The session will cover key theories including Adam Smith's theory of absolute advantage, David Ricardo's theory of comparative advantage, Thomas Malthus' population theory, and Karl Marx's theory of surplus value. Students will explore how these theories explain the mechanisms of economic growth, the role of different economic factors, and their implications for policy-making. This lecture aims to provide students with a historical perspective on economic growth theories and their relevance to contemporary economic and sustainable development challenges.

Labs:

- Students will analyze and compare the key concepts of Adam Smith's absolute advantage, David Ricardo's comparative advantage, Thomas Malthus' population theory, and Karl Marx's surplus value theory.
- Students will work in groups to present case studies that illustrate the application of these classic theories in historical and contemporary contexts.
- Students will collaboratively create a visual map that connects the classic economic growth theories with modern economic challenges.

Software: LibreOffice Calc, Google Sheets

Topic 5: Limits to Growth

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will explore the concept of "Limits to Growth," which challenges the traditional view of unlimited economic growth. The session will focus on the constraints imposed by finite natural resources, environmental degradation, and the carrying capacity of ecosystems. Students will examine key arguments and theories that highlight the potential limits to economic expansion, discussing the implications for policy-making and sustainable development. This lecture aims to provide students with an understanding of the limitations imposed by resource constraints and environmental factors on economic growth, and to highlight the importance of sustainable practices to ensure long-term economic stability.

Labs:

- Students will work in groups to identify and discuss real-world examples where resource constraints and environmental limits have impacted economic growth.

Software: LibreOffice Calc, Google Sheets

Topic 6: Liveable Cities

2 hr lect, 2 hr lab,-9 hr independent work

Lecture Description

In this lecture, students will examine the concept of livable cities and the strategies that contribute to creating urban environments that are sustainable, inclusive, and resilient. The session will explore key topics such as urban sprawl, land-use planning, and urban planning principles aimed at fostering community development and improving transportation systems. Students will also delve into modern frameworks like LEED v4.1 for cities and communities, inclusive and affordable housing, and the relationship between cities and climate change.

Labs:

- Students will analyze the impact of urban sprawl on communities and the environment, discussing possible mitigation strategies.
- Students will work in groups to develop urban planning proposals that integrate transportation, community-building, and climate resilience.

- Students will present their findings on LEED v4.1 certification for cities and communities, discussing how this framework helps build sustainable urban environments.

Software: QGIS

Topic 7: Population Dynamics

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description

In this lecture, students will explore the concept of population dynamics, examining the patterns and processes that influence population size, structure, and distribution. The session will cover key demographic concepts such as birth rates, death rates, fertility rates, migration, and age structure. Students will discuss the factors driving changes in population dynamics, including economic development, healthcare, education, and cultural factors. The implications of population dynamics on resources, environmental sustainability, and economic development will also be addressed. This lecture aims to provide students with a comprehensive understanding of how population changes impact sustainable development and the strategies that can be employed to manage these changes effectively.

Labs:

- Students will work in groups to identify and discuss factors driving changes in population dynamics, including economic development, healthcare, education, and cultural influences.
- Students will collaboratively create a visual map that illustrates the impacts of population dynamics on resources, environmental sustainability, and economic development

Software: R, Google Sheets

Topic 8: Sustainable Development

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will delve into the concept of sustainable development, exploring its definitions, principles, and significance in the modern world. The session will cover the three pillars of sustainable development: economic growth, environmental protection, and social equity. Students will examine the United Nations' Sustainable Development Goals (SDGs) and their role in guiding global efforts towards sustainability. The lecture will also discuss challenges and strategies for achieving sustainable development in various sectors, including energy, agriculture, and urban planning. This lecture aims to equip students with a thorough understanding of sustainable development and inspire them to incorporate sustainability principles into their personal and professional lives.

Labs:

- Students will analyze the three pillars of sustainable development: economic growth, environmental protection, and social equity, and how they interrelate.
- Students will work in groups to explore the United Nations' Sustainable Development Goals (SDGs), identifying specific goals and their relevance to different sectors.
- Students will collaboratively create a visual map that connects the SDGs with the three pillars of sustainable development, highlighting potential challenges and strategies for implementation.

Software: R, Google Sheets

Topic 9: Natural Resources and Climate Change

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will delve into various alternative energy sources, including solar, wind, and bioenergy. They will learn about the economic factors that influence the adoption and viability of these alternative sources, such as investment costs, technological advancements, and market incentives. The lecture will include a cost-benefit analysis comparing alternative energy sources to conventional ones, highlighting their economic advantages and challenges. Additionally, students will analyze the impact of alternative energy sources on energy markets and economic development, considering how they contribute to sustainability and reshape energy landscapes.

Labs:

- Students will engage with interactive presentations to understand different alternative energy sources and their economic aspects.
- Students will analyze case studies to evaluate the economic impact of alternative energy sources.
- Students will collaborate in a group activity to assess the role of alternative energy in shaping future energy markets and economic development.

Software: R, Google Sheets

Topic 10: Sustainable Sites

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will be introduced to the principles of sustainable site design and development, focusing on minimizing environmental impacts while enhancing ecosystem services. The lecture will cover key concepts such as site selection, land use planning, stormwater management, and biodiversity conservation. Students will also explore the role of sustainable materials and energy-efficient infrastructure in creating environmentally friendly and economically viable spaces. Emphasis will be placed on real-world examples of sustainable site projects, as well as the regulatory frameworks and certification systems, such as LEED, that guide sustainable site practices. By the end of the lecture, students will have a clear understanding of how

to approach sustainable site development in various contexts, including urban, suburban, and rural environments.

Labs:

- Students will analyze key concepts such as food security, food sovereignty, and the environmental impacts of agriculture.
- Students will work in groups to identify and discuss the challenges and opportunities in ensuring a sustainable global food supply, including climate change, population growth, and technological advancements.
- Students will collaboratively create a visual map that illustrates the global food supply chain, highlighting the critical factors that influence food availability, sustainability, and equity.

Software: QGIS, LibreOffice Calc

Topic 11: Green Buildings

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description

In this lecture, students will be introduced to the fundamental concepts of green buildings, focusing on how sustainable design and construction methods can reduce environmental impacts and enhance energy efficiency. Key topics will include the definition of green buildings, the process of green building design, and the role of passive heating and cooling concepts. Students will learn about various strategies for heating, cooling, and ventilating green buildings, with a particular focus on energy-efficient technologies. The lecture will also cover alternative cooling strategies and explore how green buildings contribute to improved indoor environmental quality. By the end of the lecture, students will understand the essential components of designing and maintaining green buildings that meet both environmental and human health standards.

Labs:

- Students will explore real-world examples of green buildings to understand how sustainable design principles are applied in practice.
- Students will work in teams to analyze case studies on green building design processes, focusing on heating, cooling, and ventilation strategies.
- Students will participate in a hands-on activity to design a conceptual green building, incorporating energy-efficient systems for heating, cooling, and ventilation.

Software: R, Google Sheets

Topic 12: Energy Economics: Past, Present, and Prospects for the Future

2 hr lect, 2 hr lab, 9 hr independent work

Lecture Description:

In this lecture, students will explore various policies and practices aimed at promoting sustainable development. The session will cover the development and implementation of policies at different levels—local, national, and international—

	that address environmental, economic, and social sustainability. Students will examine case studies of successful sustainable development policies and practices across various sectors, including energy, transportation, and waste management. The lecture will also discuss the role of different stakeholders, including governments, businesses, and non-governmental organizations (NGOs), in advancing sustainable development goals. This lecture aims to provide students with practical insights into how effective policies and practices can drive sustainable development and address global challenges. **Labs** • Students will analyze case studies of successful sustainable development policies and practices, focusing on different sectors such as energy, transportation, and waste management. • Students will work in groups to identify and discuss the roles of various stakeholders—governments, businesses, NGOs—in advancing sustainable development goals. • Students will collaboratively create a visual map that illustrates key policies and practices for sustainable development, highlighting the roles of different stakeholders and the impact of these policies on sustainability. Software: R, Google Sheets
Methodology	**Learning Evaluation Methods** Learning Evaluation Methods for this course use a summative assessments to holistically measure students' understanding and ability to apply sustainable development principles. These methods assess not only students' theoretical knowledge but also their capacity to analyze, plan, and propose solutions that align with sustainability goals. The summative assessment, totalling 100 points, includes three components: • The ASU Initiative which involves students completing a certification or module from Arizona State University that focuses on sustainable development or related practices. This assessment element reinforces foundational knowledge and recognizes students' competence. • Open-ended questions and mini-case studies challenging students to apply theoretical principles to realistic scenarios. This section evaluates students' critical thinking skills, their ability to analyze complex sustainability issues, and their effectiveness in communicating thoughtful and contextually relevant responses. • The main project. A project in which students develop a comprehensive Sustainable Development Plan for a hypothetical small town or community. The project requires students to balance the goals of economic growth, environmental preservation, and social equity within their plan, incorporating innovative solutions such as green technology, sustainable agriculture, and waste reduction strategies. **Learning Evaluation Criteria** • Arizona State University (ASU) certification:

- Demonstrate proficiency in sustainable development or related practices

- Open Ended Questions and Minicases:
  - Clarity and accuracy of answers
  - Application of key concepts and principles
  - Logical reasoning, critical thinking and problem-solving skills
  - Completeness of responses
  - Ability to analyze case studies or scenarios
- Main Project Evaluation Criteria:
  Assessment is based on the depth of research, feasibility of proposed solutions, and creativity in aligning the development plan with sustainable principles.
  The following aspects are evaluated:
  - Relevance and depth of research or analysis
  - Practical application of course concepts
  - Quality and feasibility of proposed solutions or strategies
  - Clarity of presentation (written or oral)
  - Team collaboration and contribution

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Evaluation rate	Grade description	Grading letters
90 % - 100 %	Excellent	A
80 % - 89 %	Very good	B
70 % - 79 %	Good	C
60 % - 69 %	Satisfactory	D
45 % - 59 %	Sufficient	E
44 % - 0	Fail	F

Final Mark Allocation Criteria.

1	Summative Assesment	Points
1.1	ASU Initiative	20
1.2	Open Ended Questions and Minicases.	35
1.3	Project: Sustainable Development Plan for a hypothetical small town or community	45
	Total of Summative Assesment	**100**

Bibliography	*Recommended Textbooks:* Hess, P. N. (2016). *Economic Gowth and Sustainable Development* (2nd ed.). Routledge. Robertson, M. (2021). *Sustainability principles and practice* (3rd ed.). Routledge.
Educational Resources	Required resources include access to computers and whiteboards (equipment acquired with the reZEB budget) for running the software for energy analysis and for video presentations, and projectors for lectures. Facilities for virtual or in-person field visits to energy sites and guest lectures are also essential. Integrating simulations related to sustainable resource management and development into the curriculum will offer practical learning experiences for the needs of the course. Furthermore, technologies such as LibreOffice Calc for spreadsheet management, GnuCash for financial accounting, Google Sheets for collaborative data analysis, R for statistical analysis and data visualization, and QGIS for geographic information system (GIS) analysis will be employed to support students in budgeting, financial analysis, and managing sustainability-related data.

Institution	UNI - Universum International College
Module (Title)	**ENERGY MANAGEMENT**
Full Name of the Professor	
Hours:	Lectures: 24 hours, practice: 48 lab hours, independent student's work: 110 learning hours Total: 180 hr.
Program	• Degree: MA • Study program: Management • Academic year & semester: 2nd year – 3rd semester • No. of ECTS: 6 ECTS (180 hr) / New Module • Mandatory • Starting during the academic year: 2024/2025
Learning Outcomes	This Energy Management course provides a comprehensive exploration of energy systems, focusing on efficient resource utilization and sustainability. Students will examine principles of energy finance, renewable energy technologies, and building management systems. The course emphasizes practical learning through simulations and real-world case studies, integrating advanced software tools such HVAC. Further, it will use EnergyPlus for building simulations and the Open Energy Modelling Framework (Oemof) for system analysis. Students will also engage with global experts via online conferencing to gain diverse insights into energy consumption and management strategies. By the end, students will acquire the skills to analyze, manage, and optimize energy resources effectively for both residential and commercial applications. Upon completion of this course, students will be able to: **Knowledge and understanding** • Analyze and evaluate energy consumption patterns and management strategies in residential and commercial settings. • Utilize advanced software tools, such as EnergyPlus and Oemof, for energy system simulations and financial modeling. **Capacity to apply knowledge and understanding** • Develop and apply strategies for optimizing energy resources and improving sustainability. • Interpret and utilize data from energy information systems to make informed decisions.

	• Engage with industry experts and integrate global perspectives into energy management practices. • Assess the financial implications of energy projects and recommend cost-effective solutions for energy management. **Transversal skills** • Apply critical thinking and problem-solving skills to analyze energy management data and make informed decisions. • Effectively communicate complex energy management concepts and strategies to diverse audiences.
Content	**<u>Topic 1: Course Introduction</u>** 2 hr lect, 4hr lab, 3 hr independent work **Lecture Description** In this introductory lecture, students will receive an overview of the course objectives, structure, and key topics to be covered. They will gain an understanding of the importance of studying energy management within the broader context of business management. Additionally, students will be introduced to basic energy concepts and terminology, setting the foundation for more in-depth exploration in subsequent lectures. This session aims to equip students with a clear roadmap for the course and to spark their interest in the critical issues surrounding energy management and sustainability. **Labs:** • Students will collaboratively build a visual map of key energy management terms and ideas, identifying how these concepts intersect and impact business strategies. **<u>Topic 2: Energy Management Essentials</u>** 2 hr lect, 4hr lab, 7 hr independent work **Lecture Description:** In this lecture, students will gain a comprehensive understanding of energy management principles and practices essential for both organizations and individuals. The focus will be on the systematic approach to managing energy use, including the assessment of energy consumption patterns, the development of energy-saving strategies, and the implementation of energy efficiency measures. Key topics will include the value of energy management, the energy management profession, principles of energy management, and breaking barriers to energy conservation. Students will also learn about professional associations related to energy management and their role in promoting industry standards and practices. The lecture will address the regulatory and policy frameworks influencing energy management, as well as emerging trends and technologies in the field. **Labs:**

- Students will participate in discussions to explore the real-world applications of energy management principles, sharing insights and best practices from various sectors and regions.
- Students will analyze case studies of successful energy management initiatives, identifying key strategies, challenges, and outcomes to understand practical applications.
- Students will conduct a mock energy audit and develop an energy management plan, applying learned techniques to assess energy use and recommend efficiency improvements.

Topic 3: Effective Energy Management

2hr lect, 4hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will explore the principles and practices of effective energy management. They will learn about energy management systems (EMS), energy auditing, and the implementation of energy efficiency measures. The lecture will also cover strategies for optimizing energy consumption, reducing energy costs, and enhancing sustainability in various industries. Students will understand the role of technology and innovation in energy management and how to integrate these elements into comprehensive energy management plans.

Labs:

- Students will engage with multimedia presentations to understand the components and functions of energy management systems (EMS).
- Students will analyze case studies illustrating successful energy management practices in various industries.
- Students will engage in a group activity to develop a comprehensive energy management plan, focusing on optimizing energy consumption and reducing costs.

Topic 4: Energy Auditing

2 hr lect, 4hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into the process and significance of energy auditing. They will learn how to conduct comprehensive energy audits to identify energy consumption patterns and inefficiencies within various facilities. The lecture will cover different types of energy audits, methodologies for data collection and analysis, and the tools and technologies used in the auditing process. Students will also explore how to interpret audit results to recommend effective energy-saving measures. By the end of this lecture, students will have a solid understanding of how to perform energy audits and use the findings to enhance energy efficiency and sustainability in organizations.

Labs:

- Students will engage with multimedia presentations to understand the steps and methodologies involved in conducting energy audits.

Software: Google Sheets, EnergyPlus

Topic 5: Economic Analysis

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will explore the fundamental principles and techniques of economic analysis with a focus on capital investments. They will learn about the general characteristics of capital investments, sources of funds, and tax considerations that impact project viability. The lecture will cover essential concepts such as the time value of money and various project measures of worth, including cost-benefit analysis, net present value (NPV), internal rate of return (IRR), and payback period calculations.

Labs:

- Students will engage with multimedia presentations to understand the principles and techniques of economic analysis.
- Students will participate in discussions on the importance of economic analysis in evaluating projects.
- Students will engage in a group activity to perform an economic analysis of a proposed project and present their findings.

Software: Google Sheets, GNUCash

Topic 6: Electrical Distribution Systems

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will examine the critical components and functions of electrical distribution systems. They will learn about the basic electrical systems in buildings and facilities, including definitions and key concepts. The lecture will cover voltages in AC power systems, phases and frequencies, and both single-phase and three-phase electrical systems. Students will also explore the relationships of voltage, current, and resistance, as well as Ohm's law for DC and AC loads. Additional topics include power in various AC circuits, reactive power, power factor correction, and the role of smart grids in modern electrical distribution. By understanding these elements, students will gain insights into the design, operation, and optimization of electrical distribution systems.

Labs:

- Students will engage with multimedia presentations to understand the structure and components of electrical distribution systems.
- Students will analyze case studies that illustrate the application of electrical distribution concepts in real-world scenarios.
- Students will engage in a group activity to evaluate the implementation of smart grid technologies in modern electrical distribution systems.

Software: Oemof, MATLAB

Topic 7: Energy Management Control Systems

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into the fundamentals and components of energy management control systems. They will explore how these systems are designed to monitor, control, and optimize energy consumption in various facilities. The lecture will cover the types of control systems, including building management systems (BMS) and smart grids, and their role in improving energy efficiency and reducing operational costs. Students will learn about the integration of sensors, automation, and data analytics in controlling energy use, as well as the importance of real-time monitoring and predictive maintenance. The lecture will also address the challenges and benefits of implementing energy management control systems in both new and existing buildings. By the end of this lecture, students will have a thorough understanding of how these systems contribute to sustainable energy management and their impact on overall building performance.

Labs:

- Students will engage with interactive presentations to gain a clear understanding of the structure and function of energy management control systems.
- Students will analyze real-world examples that demonstrate the effectiveness of energy management control systems in various industries.
- They will also work in groups to develop a basic design for an energy management control system tailored to a specific building, focusing on maximizing energy efficiency and sustainability.

Software: Google Sheets, EnergyPlus

Topic 8: Renewable Energy Sources and Water Management

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will investigate the integration of renewable energy sources with water management practices. They will learn about various renewable energy technologies, including solar, wind, hydro, and geothermal, and how these technologies interact with water resources. The lecture will cover topics such as the challenges of balancing energy production with water usage, the benefits of renewable energy in reducing water consumption, and strategies for effective water management in renewable energy projects. Students will also explore case studies of projects that have successfully integrated renewable energy with water management and discuss their implications for sustainable development. By the end of this lecture, students will have a comprehensive understanding of how to manage water resources while implementing renewable energy solutions.

Labs:

- Students will engage with multimedia presentations to understand different renewable energy technologies and their impact on water management.

- Students will analyze case studies that illustrate successful integration of renewable energy and water management practices.
- Students will work in groups to design a renewable energy project with a focus on effective water management strategies.

Software: Oemof, HOMER

Topic 9: Creating Green Buildings

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will explore the principles and practices involved in creating green buildings. They will learn about the key components of green building design, including sustainable materials, energy-efficient systems, and environmentally friendly construction practices. The lecture will cover topics such as building certifications (e.g., LEED), the integration of renewable energy technologies, and strategies for reducing a building's environmental impact. Students will examine case studies of successful green building projects and discuss the benefits and challenges associated with green construction. By the end of this lecture, students will have a thorough understanding of how to design and implement green building practices to achieve sustainability goals.

Labs:

- Students will engage with multimedia presentations to understand the principles of green building design and construction.
- Students will analyze case studies that demonstrate successful green building practices and their impact.
- Students will work in groups to develop a design plan for a green building, incorporating sustainable materials and energy-efficient systems.

Software: Google Sheets, EnergyPlus

ASU Certificate Due

Topic 10: Green House Gas Emissions Management

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will examine the strategies and practices involved in managing greenhouse gas (GHG) emissions. They will learn about the sources of GHG emissions, including industrial processes, transportation, and energy production, and the impact these emissions have on climate change. The lecture will cover topics such as emissions monitoring and reporting, reduction strategies, and the role of carbon credits and offsets. Students will also explore case studies of organizations that have successfully implemented GHG management programs and discuss the challenges and benefits associated with reducing emissions. By the end of this lecture, students will have a comprehensive understanding of how to manage and reduce GHG emissions to mitigate environmental impact.

Labs:

- Students will engage with multimedia presentations to understand GHG emissions sources, monitoring, and reduction strategies.
- Students will analyze case studies that illustrate successful GHG management programs and their outcomes.
- Students will work in groups to develop a GHG management plan for a hypothetical organization, including strategies for emissions reduction and reporting.

Software: Google Sheets, GNUCash

Topic 11: Human Behavior and Facility Energy Management

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description

In this lecture, students will explore the relationship between human behavior and facility energy management. They will learn how occupant behavior and habits influence energy consumption in buildings and the strategies that can be employed to improve energy efficiency through behavioral changes. The lecture will cover topics such as the impact of user behavior on heating, cooling, and lighting systems, the role of energy awareness programs, and the use of technology to monitor and influence energy use. Students will also examine case studies of facilities that have successfully integrated behavioral strategies into their energy management practices. By the end of this lecture, students will understand how human behavior affects energy consumption and how to leverage behavioral insights to enhance facility energy management.

Labs:

- Students will engage with multimedia presentations to understand the impact of human behavior on facility energy management.
- Students will analyze case studies that demonstrate successful integration of behavioral strategies into energy management practices.
- Students will work in groups to design an energy management plan that incorporates behavioral interventions to improve energy efficiency in a facility.

Software: Google Sheets, MATLAB

Topic 12: Web-Based Building Automation Controls and Energy Information Systems

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into web-based building automation controls and energy information systems. They will explore how these technologies are used to manage and optimize building energy performance through remote monitoring and control. The lecture will cover topics such as the components of building automation systems (BAS), integration with energy information systems (EIS), and the benefits of real-time data analysis for improving energy efficiency. Students will also examine case studies of buildings that have successfully implemented web-based

	controls and EIS, discussing the impact on energy consumption and operational efficiency. By the end of this lecture, students will have a comprehensive understanding of how web-based technologies enhance building management and energy performance. **Labs:** • Students will engage with multimedia presentations to understand the structure and functionality of building automation controls and energy information systems. • Students will analyze case studies that illustrate the successful application of building automation and energy information systems in various settings. • Students will work in groups to design a web-based building automation system for a hypothetical building scenario, focusing on optimizing energy performance. Software: Google Sheets, EnergyPlus

Methodology	**Learning Evaluation Methods**
	
	The Energy Management course with a focus on energy uses a diverse evaluation approach to comprehensively assess student performance. Students will complete two written tests to evaluate their understanding of financial principles and their application in the energy sector. They are also required to complete an Arizona State University (ASU) certification module, demonstrating proficiency in relevant energy management skills. Interactive class activities and discussions are essential for reinforcing concepts and developing practical skills, with attendance and active participation playing a key role in fostering engagement and collaborative learning. Additionally, a group project (course project) will involve analyzing financial scenarios related to energy markets and proposing strategic solutions. This varied evaluation method ensures students gain both theoretical knowledge and practical experience in energy management.
	
	Learning Evaluation Criteria
	• Test Evaluation Criteria:
	  • Clarity and accuracy of answers
	  • Application of key concepts and principles
	  • Logical reasoning and problem-solving skills
	  • Completeness of responses
	  • Ability to analyze case studies or scenarios
	• Arizona State University (ASU) certification:
	  • Demonstrate proficiency in relevant energy management skills
	• Attendance & Participation:
	  • quantity and quality of engagement during the lectures
	• Course Project Evaluation Criteria:
	  • Relevance and depth of research or analysis

- Practical application of course concepts
- Quality and feasibility of proposed solutions or strategies
- Clarity of presentation (written or oral)
- Team collaboration and contribution

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Evaluation rate	Grade description	Grading points
91 - 100	Excellent	10.0
81 - 90	Very good	9.0
71 - 80	Good	8.0
61 - 70	Satisfactory	7.0
51 - 60	Sufficient	6.0
50 – less	Fail	5.0
	No data (NR)	0.0

Final Mark Allocation Criteria.

Evaluation Component	Description of the Evaluation Method	Percentage
Attendance & Participation	"Attendance" means physical participation during lectures while participation refers to the quantity and quality of engagement during the lectures;	10%
ASU Certificate	Students will complete the training provided by Arizona State University.	10%
Test I	Students will complete the first test after six lectures.	20%
Course Project	Students will undertake to complete a project that demonstrate their ability to connect theory to practice. The project will being in the early stages of the course and will end by the final lecture.	40%
Test II	Students will take part in the second. The test includes content from topic 7 to 12.	20%
Total		**100**

Bibliography	*Recommended Textbooks:* Roosa, S. A., Doty, S., & Turner, W. C. (2018). Energy Management Handbook (9th ed.). River Publishers. Capehart, B. L., Turner, W. C., & Kennedy, W. J. (2016). *Guide to Energy Management* (8th ed.). River Publishers.
Educational Resources	Required resources include access to computers (purchased with reZEB budget) and the internet for research, software for energy analysis, projectors for lectures, and a smart boards for video presentations. Facilities for virtual or in-person field visits to energy sites and guest lectures are also essential. Utilizing the whiteboards' advanced conferencing features (purchased with reZEB budget) to connect with global experts in energy resources will provide students with diverse perspectives and real-world insights into energy consumption and management strategies. First, HVAC software (purchased with the reZEB budget) will be utilized for the needs of this course. Tools such as GNUCash for financial tracking, Google Sheets for data analysis, the Open Energy Modelling Framework (Oemof) for energy system modeling, and EnergyPlus for building energy simulations will be used. Additionally, MATLAB and R will support complex simulations and data analysis, while the basic version of HOMER will help model and optimize renewable energy systems, enhancing students' understanding and management of energy resources.

MODULE: FINANCIAL MANAGEMENT

Institution	UNI - Universum International College
Module (Title)	**FINANCIAL MANAGEMENT**
Full Name of the Professor	
Hours:	Lectures: 24 hours, practice: 48 lab hours, independent student's work: 110 learning hours Total: 180 hr.
Program	• Degree: MA • Study program: Management • Academic year & semester: 2nd year – 3rd semester • No. of ECTS: 6 ECTS (180 hr) / New Module • Mandatory • Starting during the academic year: 2024/2025
Learning Outcomes	The Financial Management course at UNI - Universum International College has been designed to provide students with a robust understanding of financial principles and their applications, specifically within the context of renewable energy technologies in buildings. This course integrates traditional financial management concepts with the innovative and growing field of sustainable energy. By focusing on the financial dynamics of renewable energy projects, students will learn to navigate the economic landscape of green technologies, preparing them for careers in the evolving market of sustainable energy solutions. Upon completion of this course, students will be able to: **Knowledge and understanding** • Understand the market economy and its mechanisms, particularly how they integrate with sustainable practices and renewable energy technologies. **Capacity to apply knowledge and understanding** • Analyze financial data and develop comprehensive cost management strategies for renewable energy projects, enhancing their professional and personal financial decision-making skills. • Recognize the critical role of managerial accounting in the renewable energy sector, applying its principles to promote business sustainability and uphold professional ethics in financial decision-making. **Transversal skills**

	• Apply critical thinking and problem-solving skills to analyze financial data and make informed decisions. • Effectively communicate complex financial concepts and strategies to diverse audiences. •
Content	**<u>Topic 1: Course Introduction</u>** 2 hr lect, 4hr lab, 2 hr independent work **Lecture Description** In this introductory lecture, students will receive an overview of the course objectives, structure, and key topics to be covered. They will gain an understanding of the importance of studying financial management with a focus on energy in the context of business management. Additionally, students will be introduced to basic financial and energy concepts and terminology, setting the foundation for more in-depth exploration in subsequent lectures. This session aims to equip students with a clear roadmap for the course and to spark their interest in the critical issues surrounding financial management in the energy sector and sustainability. **Labs:** • Students will collaboratively build a visual map of key financial and energy terms and ideas, identifying how these concepts intersect and impact business strategies. **<u>Topic 2: An Overview of Financial Management</u>** 2 hr lect, 4 hr lab, 8 hr independent work **Lecture Description:** In this lecture, students will be introduced to the fundamental concepts of financial management, with a specific focus on the energy sector. They will learn about the key principles of financial management, including budgeting, forecasting, financial analysis, and investment decision-making. The lecture will cover the unique financial challenges and opportunities in the energy sector, such as capital-intensive projects, regulatory impacts, and market volatility. Students will explore different financial instruments and methods used to manage energy projects, and they will learn how to apply financial management principles to real-world business situations, focusing on strategic decision-making and optimizing financial performance in the energy industry. **Labs:** • Students will analyze case studies to understand practical applications of financial management concepts in the energy sector, examining successful strategies and common challenges. • Students will engage in a hands-on activity to apply financial analysis tools and techniques to energy data, developing skills in financial modeling and decision-making. **<u>Topic 3: Financial Statements, Cash Flow, and Taxes</u>**

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into the fundamental components of financial statements, focusing on the balance sheet, income statement, and cash flow statement. They will learn how to interpret these documents to assess a company's financial health, particularly within the energy sector. The lecture will also cover the importance of cash flow management and its impact on business operations and decision-making. Additionally, students will explore the role of taxes in financial management, understanding tax implications for energy projects and investments.

Labs:

- Students will engage with multimedia presentations to understand the structure and components of financial statements.
- Students will analyze case studies that illustrate the application of financial statements and cash flow analysis in the energy sector.
- Students will engage in a group activity to evaluate the tax implications of energy projects and investments.

Topic 4: Analysis of Financial Statements

2 hr lect, 4 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will learn to thoroughly analyze financial statements, focusing on the balance sheet, income statement, and cash flow statement. They will explore various methods and tools used to interpret these documents, such as ratio analysis and trend analysis. The lecture will cover the importance of financial statement analysis in assessing a company's financial health and performance, particularly within the energy sector. Students will also examine how to identify potential financial issues and opportunities for improvement.

Labs:

- Students will engage with multimedia presentations to learn about different types of financial statements and their components.

Software: Microsoft Excel, Wave, Mint

Topic 5: Energy Finance and Economics

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into the fundamental economic principles that govern energy markets, gaining insights into supply and demand, pricing mechanisms, and market structures. They will learn about the various factors that influence energy prices and market dynamics, such as production costs, geopolitical events, and technological advancements. The lecture will explore the economic impact of energy consumption on businesses and broader economies, highlighting both the costs and benefits. Additionally, students will analyze the role of government policies and regulations in shaping energy markets, understanding how

interventions like subsidies, taxes, and environmental regulations affect market behavior and energy strategies.

Labs:

- Students will engage in project-based learning to understand economic principles and factors affecting energy markets.
- Students will analyze case studies to understand the economic impact of energy consumption.
- Students will explore the role of government policies through a group activity evaluating different regulatory approaches.

Software: Microsoft Excel, Whiteboards

Topic 6: Geopolitics & World Energy Markets

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will explore the complex interplay between geopolitics and global energy markets. They will examine how political decisions, international relations, and global conflicts influence energy supply, demand, and pricing. The lecture will cover key geopolitical events and trends that have shaped the energy landscape, such as oil embargoes, regional conflicts, and the rise of renewable energy sources. Students will also analyze the strategic importance of energy resources for national security and economic stability, understanding how countries leverage energy assets to exert influence on the global stage.

Labs:

- Students will engage with multimedia presentations to learn about the geopolitical factors affecting global energy markets.
- Students will analyze case studies that highlight significant geopolitical events and their effects on the energy sector.
- Students will collaborate in a group activity to map out the geopolitical landscape of energy resources and predict future trends and challenges.

Topic 7: Financing Large Energy Projects

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into the complexities of financing large energy projects, with a focus on the diverse financial structures used in the energy sector. The lecture will cover key financial instruments such as project financing, equity, debt, and green bonds. Students will explore the challenges and risks faced in securing funding for large-scale energy infrastructure, particularly for renewable projects like wind farms, solar power plants, and hydropower stations. The discussion will also highlight the role of public-private partnerships (PPPs), international financial institutions, and government incentives in facilitating the development of energy projects. Real-world case studies will be used to illustrate

how innovative financing strategies can drive the transition to a sustainable energy future.

Labs:

- Students will also participate in a group activity to analyze a real energy project financing model, identifying risks and proposing mitigation strategies Software: Microsoft Excel

Topic 8: The Economics of Conventional Energy Sources

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will explore the types and characteristics of conventional energy sources, including coal, oil, and natural gas. They will learn about the economic implications of using these sources, focusing on cost factors, market dynamics, and the broader economic impacts. The lecture will also address the environmental and social impacts associated with conventional energy use, examining issues such as pollution, health risks, and social equity. Additionally, students will analyze the role of conventional energy sources in both current and future energy markets, considering their continuing relevance and potential shifts in energy demand.

Labs:

- Students will engage with interactive presentations to learn about different conventional energy sources and their economic characteristics.
- Students will analyze case studies to examine the environmental and social impacts of conventional energy use.
- Students will collaborate in a group activity to evaluate the role of conventional energy sources in current and future energy markets.

Software: Microsoft Excel

Topic 9: The Economics of Alternative Energy Sources

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will delve into various alternative energy sources, including solar, wind, and bioenergy. They will learn about the economic factors that influence the adoption and viability of these alternative sources, such as investment costs, technological advancements, and market incentives. The lecture will include a cost-benefit analysis comparing alternative energy sources to conventional ones, highlighting their economic advantages and challenges. Additionally, students will analyze the impact of alternative energy sources on energy markets and economic development, considering how they contribute to sustainability and reshape energy landscapes.

Labs:

- Students will engage with interactive presentations to understand different alternative energy sources and their economic aspects.

- Students will analyze case studies to evaluate the economic impact of alternative energy sources.
- Students will collaborate in a group activity to assess the role of alternative energy in shaping future energy markets and economic development.

Software: GNUCash, Wave

Topic 10: Real Options and Applications in the Energy Industry

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description:

In this lecture, students will gain a comprehensive understanding of the concept of energy security and its significance for both national and global stability. They will learn about the various factors that influence energy security, including geopolitical tensions, economic conditions, and environmental concerns. The lecture will explore strategies and policies designed to enhance energy security and manage associated risks, such as diversification of energy sources, strategic reserves, and international cooperation.

Labs:

- Students will engage with interactive presentations and current data to grasp the concept and importance of energy security.
- Students will analyze case studies to understand various strategies and policies for enhancing energy security.
- Students will collaborate in a group activity to develop and evaluate strategies for managing energy security risks and challenges.

Software: Microsoft Excel, GNUCash

Topic 11: Introduction to Energy Risk Management

2 hr lect, 2 hr lab, 10 hr independent work

Lecture Description

In this lecture, students will be introduced to the principles and practices of energy risk management, focusing on the identification, assessment, and mitigation of risks in the energy sector. They will learn about various types of risks, including market risk, credit risk, operational risk, and regulatory risk, and explore their impacts on energy companies and projects. The lecture will cover tools and techniques used for risk assessment, such as scenario analysis, value-at-risk (VaR), and stress testing, as well as risk mitigation strategies like hedging, insurance, and diversification. The importance of understanding risk management in the context of volatile energy markets, changing regulations, and the transition to renewable energy will be emphasized.

Labs:

- Students will engage with interactive presentations and industry reports to understand the key concepts and tools in energy risk management.
- Students will analyze real-world case studies to evaluate how energy companies manage risks associated with their operations.

	• Students will collaborate in a group activity to develop risk management plans for an energy project, addressing different types of risks and proposing appropriate mitigation strategies. Software: Microsoft Excel **<u>Topic 12: Energy Derivatives and Markets</u>** 2 hr lect, 2 hr lab, 10 hr learning **Lecture Description:** In this lecture, students will explore the role of energy derivatives in managing risk and optimizing returns in energy markets. They will learn about the types of energy derivatives, including futures, options, and swaps, and their applications in hedging against price volatility in energy commodities such as oil, gas, and electricity. The lecture will cover the structure and functioning of energy markets, focusing on key market participants, price determinants, and the influence of geopolitical and economic factors. Students will also analyze how energy trading strategies can be used by companies to manage financial risks, enhance price stability, and support decision-making processes. Additionally, the lecture will emphasize the regulatory environment and ethical considerations related to energy trading. **Labs**: • Students will engage with interactive simulations to understand the use of energy derivatives in managing price risks in the energy market. • Students will analyze real-world case studies to evaluate trading strategies used by energy companies. • Students will collaborate in a group activity to develop a risk management plan using energy derivatives, focusing on managing the price volatility of a specific energy commodity.
Methodology	**Learning Evaluation Methods** The Financial Management course with a focus on energy uses a diverse evaluation approach to comprehensively assess student performance. Students will complete two written tests to evaluate their understanding of financial principles and their application in the energy sector. They are also required to complete an Arizona State University (ASU) certification module, demonstrating proficiency in relevant financial management skills. Interactive class activities and discussions are essential for reinforcing concepts and developing practical skills, with attendance and active participation playing a key role in fostering engagement and collaborative learning. Additionally, a group project (course project) will involve analyzing financial scenarios related to energy markets and proposing strategic solutions. This varied evaluation method ensures students gain both theoretical knowledge and practical experience in financial management within the energy industry. **Learning Evaluation Criteria** • Test Evaluation Criteria: • Clarity and accuracy of answers

- Application of key concepts and principles
- Logical reasoning and problem-solving skills
- Completeness of responses
- Ability to analyze case studies or scenarios

- Arizona State University (ASU) certification:
  - Demostrate proficiency in relevant financial management skills
- Attendance & Participation:
  - Quantity and quality of engagement during the lectures
- Course Project Evaluation Criteria:
  - Relevance and depth of research or analysis
  - Practical application of course concepts
  - Quality and feasibility of proposed solutions or strategies
  - Clarity of presentation (written or oral)
  - Team collaboration and contribution

Learning Measurement Criteria.

A 100-points scale is used for grading, with possible praise

Evaluation rate	Grade description	Grading points
91 - 100	Excellent	10.0
81 - 90	Very good	9.0
71 - 80	Good	8.0
61 - 70	Satisfactory	7.0
51 - 60	Sufficient	6.0
50 – less	Fail	5.0
	No data (NR)	0.0

Final Mark Allocation Criteria.

Evaluation Component	Description of the Evaluation Method	Percentage
Attendance & Participation	"Attendance" means physical participation during lectures while participation refers to the quantity and quality of engagement during the lectures;	10%
ASU Certificate	Students will complete the training provided by Arizona State University.	10%

	Test I	Students will complete the first test after six lectures.	20%
	Course Project	Students will undertake to complete a project that demonstrate their ability to connect theory to practice. The project will being in the early stages of the course and will end by the final lecture.	40%
	Test II	Students will take part in the second. The test includes content from topic 7 to 12.	20%
	Total		**100**
Bibliography	*Recommended Textbooks:* Simkins, B., & Simkins, R. (2013). *Energy finance and economics: Analysis and valuation, risk management, and the future of energy* (1st ed.). Wiley. Brigham, E. F., & Ehrhardt, M. C. (2019). *Financial management: Theory & practice* (16th ed.). Cengage Learning.		
Educational Resources	Utilizing the whiteboards' advanced conferencing features (purchased with reZEB budget) for interactive lectures in the field of energy resources from around the globe will provide students with diverse perspectives and real-world insights into energy consumption and management strategies. Additional software like Microsoft Excel, GNUCash, Wave and Mint will also be utilized for the needs of the course.		

Annex 5: International Business College Mitrovica (IBC-M)

MODULE: ENVIRONMENTAL LAW AND EU POLICIES

Institution	International Business College Mitrovica
Module (Title)	**ENVIRONMENTAL LAW AND EU POLICIES**
Full Name of the Professor	Jelisaveta Marjanovic
Hours:	20 hrs lectures + 20 hrs practice (exercises, etc) 110 hrs student workload 150 hrs total
Program	- Bachelor Degree in Environmental and Agricultural Management - 5 ECTS - 3rd semester (2nd year of the study program), 2024/2025 - mandatory
Learning outcomes	**Knowledge and understanding** Students will acquire knowledge to: • examine and develop an understanding of major environmental challenges facing Kosovo and the international community; • understand basic principles underlying international environmental law, EU environmental legislation and Directives and to have awareness on the harmonization with the Kosovo national legislation; • discuss and reflect on the environmental laws implementations dealing with climate change, environment protection, agriculture, energy, biodiversity conservation etc; • be aware of the broader multidisciplinary context of engineering; • understand the regulations regarding the energy certification of buildings. **Capacity in applying knowledge and understanding:** • Ability to assess key concepts in the field of environmental legislation for problem-solving across a range of contexts; • Ability to interpret the environmental legislation and compare with the EU Directives; • Ability to further enhance the knowledge of environmental law, analyse and laws and results, develop the capacity to identify factual and legal issues • Ability to carry out surveys and bibliographic searches and to consult and use databases and other sources of information • Ability to apply general and simplified procedures for the realization of energy certification of new and existing buildings; **Transversal skills:** • Ability to use diverse methods and tools of communication to communicate clearly and unambiguously with specialist and non-specialist audiences in national and international contexts;

	• Ability to manage complex and multidisciplinary work contexts and to take decisions and formulate judgments.
Content	The course covers the key issues that concern environmental policies, such as: global warming, wastage of water, climate change, etc. It includes the local as well as the EU international legal frameworks for the protection of the environment, the protection of climate change, and conservation of natural resources. Also, through assignments and class projects, the course will cover the demonstration and nature- based solution for environmental protection.

Lesson 1	International Law and Environmental Protection Green Agenda and Green Transition	90 mins lecture
Lesson 2	History and Development of Environmental Law in EU EU: Nature and Scope of Environmental Law Emerging Issues in Environmental Law	90 mins lecture 45 mins practice 45 mins
Lesson 3	Obligations and national and international agreements in the area of natural resources protection, energy efficiency and carbon footprint.	90 mins lecture 45 mins practice 45 mins
Lesson 4	Climate Change Mitigation, the International Dimension Energy saving – development of the Energy Performance of Buildings Directive (EU/2024/1275)	90 mins lecture
Lesson 5	EU Environment Protection Mechanisms-Harmonization of Law on Nature protection EU Aquis Regulations and implementation of energy saving measures – Transformation of EPBD in EU member countries	90 mins lecture 45 mins practice 45 mins
Lesson 6	Agricultural and forest land protection	90 mins lecture 45 mins practice 45 mins
Lesson 7	Nature and landscape protection	90 mins lecture 45 mins practice 45 mins
Lesson 8	Nature resource protection - energy efficiency and EU resilience policies	90 mins lecture 45 mins practice 45 mins
Lesson 9	National Legal Frameworks - Protection of Water, Air and Environment in Kosovo	90 mins lecture 45 mins practice 45 mins
Lesson 10	National legal framework - Protection of Environment under the Kosovo Legislation – what is	90 mins lecture 45 mins

	a pollutant, what is energy efficiency and what considered as green energy and how does current policy support energy resilience	practice 45 mins
Lesson 11	National legal framework – harmonisation with EU EPBD	90 mins lecture 45 mins practice 45 mins
Lesson 12	Kosovo Energy Strategy 2022-2031 Development of energy saving policies – implementation by sub law acts and regulations Construction and demolition requirements	90 mins lecture
Lesson 13	Inspectorate and process of law implementation and protection Process of obtaining construction and demolition permits, implementing standards on materials for the purpose following Energy efficiency strategy	90 mins practice
Lesson 14	Law on Waste - Waste and packaging management Construction and demolition waste – waste law and recycling in construction	90 mins lecture
Lesson 15	Industry and mining – trade regulations and environmental protection Industry and construction –inspectorate and fines – what are national requirements and what is considered as "green" or energy saving in construction as a biggest industry branch in Kosovo	90 mins lecture 45 mins practice 45 mins
Lesson 16	Chemicals management, prevention of serious accidents – legal requirements for the management of dangerous goods	90 mins lecture
Lesson 17	Process of classification and identification of new materials contributing to reduction of emission in construction – developing support for implementation of new technologies trough legal and sublegal acts. Development of national policies and incentives for the incorporation of measures for energy efficiency in construction and modification of individual and joint housing.	90 mins lecture
Lesson 18	Labeling and certification – Legal requirements and standards What is needed to implement energy saving projects, construct green buildings and produce energy efficient products?	90 mins practice
Lesson 19	Field visit to the Ministry of Environmental Protection, Spatial Planning and Infrastructure	90 mins practice

	Lesson 20	Discussion – What are the legal conditions for construction of the energy efficient buildings. What are the legal conditions of building restauration for integrating RE	90 mins practice

Methodology

Learning Evaluation Methods.

- Participation – student must be present at least 70% of lectures with active participation in discussion
- Compulsory assignment – topic of the CA shall be selected during the course based on the lessons. List shall be provided by the Lecturer, Students can select the topic from the list of the topic and have for a task to research and present the knowledge obtained through the written analysis and recommendation.
- Final Exam – It consist of written and oral part

Learning Evaluation Criteria

Written part

Description	**Allocation of points**	**Estimate**	**Total**
Issue related to concrete project task	Complexity- justification/ background/intro/value Problem statement/delimitation Link theory with practical problem	5 5 5	15
Structure and Formatting	Use reliable sources and references Proper use of tables, figures and graphics Language and executive summary	5 5 5	15
Key issues within area of study and good use of programme subjects	Critical analysis of source materials Depth comparative of analysis Correction between the problem statement and conclusions Independent thinking and analysis	5 5 5 5	20
Total			
Grade			

Project presentation

Description	**Allocation of points**	**Grade Equivalent**	**Out of 100%**
Excellent presentation • An outstanding presentation indicating evidence of wide knowledge and understanding of the subject. • Mastering of the topic with confidence while providing detailed and accurate relevant information. • Clear evidence or research and preparation. • Strong and structured arguments based on concise and persuasive approach.	For an excellent performance	12	100

	• Maintaining eye contact while focusing on attention and interest • Clear and loud speech • Questions answered to with courtesy and authority • Positive body language, formal dressing code and appropriate appearance • Use of appropriate grammar and vocabulary, demonstrating high English language proficiency • Excellent PPT presentation and its layout			
	Very Good Presentation • An excellent presentation indicating evidence of wide knowledge and understanding of the subject. • Very good explanation of the topic with fair confidence • Mastering of the topic with confidence while providing easily understood information • Providing compelling evidence for selected ideas • Actively engages and communicates with the audience • Appropriate use of dressing code and appropriate appearance • Uses appropriate grammar and vocabulary with good English language proficiency • Good PPT presentation layout	For a very good performance	10	90
	Good Presentation • The audience can understand the topic/ subject matter • Reasonable justification of ideas based on arguments • Some evidence of outside reading but mainly based on the key tasks. • Insufficient analysis and evaluation • Active engagement and communicates with the audience • Appropriate use of dressing code and appropriate appearance • A competent answer showing sound knowledge and while relating to particular theories and concepts • Uses appropriate grammar and vocabulary with adequate English language proficiency • Good PPT presentation layout	For a good performance	7	80
	Fair Presentation	For a fair performance	4	70

• Demonstrating a reasonable knowledge but lacking depth of understanding • Presenting the topic so the audience can understand it • Heavy reliance on class materials with no evidence of outside reading • Weak or no evidence of analysis and evaluation • Actively engages and communicates well with audience • Appropriate dressing code and appropriate appearance • Some errors in presentation are evident • Uses appropriate grammar and vocabulary with adequate English language proficiency • Satisfactory presentation layout			
Bare Pass Presentation • Presenting the topic so the audience can barely guess the subject matter • Mentions some relevant points but lacks focus on the question • No evidence of reading or using other sources but the class material • Notable error s ad omissions • Hardly answers the questions related to the subject matter • Weak presentations and its structure, poorly presented and not easy to follow.	For low performance	2	55
Inadequate presentation • Notably Poor presentation skills • Unable to demonstrate the minimum understanding of the subject matter • Substantial omission and errors in presentation No presentation skills and confusion • Poor introduction of the topic with no relevance • Time limits ignored • Contains evident fundamental errors and misunderstanding • Unable to answer questions • Poor English language proficiency • Clumsy presentation layout	For inadequate performance	0	0-54
Plagiarism, Cheating or Non submission of the required task	Academic offence or no work done at all	-03	NA

Learning Measurement Criteria

Performance	Excellent	Very good	For a good	Fair	Adequate	Inadequate	
Grading Percentage	> 95%	85% - 95%	75% - 85%	65% - 74%	55% - 64%	< 55%	No Exam / Plagiarism
Grade according to the ECTS Credit System	A	B	C	D	E	Fx	F
IBCM Grade	12	10	7	4	2	0	-3

Final Mark Allocation Criteria
Participation 10%
Compulsory assignment –30%
Final Exam – 60% (50% for written part and 50% for oral part)

Bibliography

The following are the recommended readings for this course.

- Principles of International Environmental Law, Principles of International Environmental Law, 4th Edition, Philippe Sands, HB ISBN: 9781108420952 on Higher Education from Cambridge., March 2018, DOI: https://doi.org/10.1017/9781108355728,
- Barry E. Hill (2018) Environmental Justice: Legal Theory and Practice, 4th Edition, Environmental Law Institute
- Alexandra B. Klass, J. B. Ruhl, James Salzman, and John Copeland Nagle (2008). The Practice and Policy of Environmental Law, Foundation Press.
- https://europa.eu/european-union/law_en
- http://www.assembly-kosova.org/common/docs/ligjet/2009_03-L-025_en.pdf
- Kovov Gazeta Zyrtare e republikes se Kosoves https://gzk.rks-gov.net/default.aspx?index=1

Educational resources

Laboratory for Environmental Management and Energy Management
5 Desktop computers
2 Laptop computers

MODULE: PROJECT MANAGEMENT

Institution	International Business College Mitrovica
Module (Title)	**PROJECT MANAGEMENT**
Full Name of the Professor	Damir Gashi
Hours:	20 hrs lectures + 20 hrs practice (exercises, etc) 110 hrs student workload 150 hrs total
Program	- Bachelor Degree in Environmental and Agricultural Management - 5 ECTS - 6th semester (3rd year of the study program), 2024/2025 - mandatory
Learning outcomes	**Knowledge and understanding** Students will acquire knowledge and understanding: • of the fundamental principles of environmental law and EU policies related to the energy efficiency and renewable energy; • of the key EU directives and regulations governing the Green Deal; • to distinguish between different policy perspectives and different levels of government pertaining to energy efficiency and renewable energy; • of the environmental benefits of energy efficiency and renewable energy, including reduced greenhouse gas emissions and decreased air pollution; • of the technology and city planning issues involved in the shift from internal combustion to energy efficiency and renewable energy; • of the peculiar aspects of the green transition (new technologies and industrial models, sustainable planning of the production processes and of the products, social awareness and informing people, training management, human resource management, administrators, and politicians) **Capacity in applying knowledge and understanding:** • Ability to identify, locate and obtain the required data; • Ability to interpret and apply relevant environmental laws and EU policies; • Ability to independently research the sustainability and resilience of the environment at different levels; to conduct analyzes, experiments, assessments and evaluations, as well as the ability to synthesize and interpret results, formulate conclusions, and present the research in written and oral form; • Ability to develop projects which sustain good quality and rationally uses natural resources (energy, raw materials, water and land); • Ability to follow-up on industry wide innovation and adjusting to standards imposed by macro-level entities.

Transversal skills:

- Ability to build partnerships and collaborations in the energy efficiency and renewable energy sector;
- Ability to communicate effectively about risks to stakeholders;
- Ability to design solutions to unfamiliar problems, which may involve other disciplines, and to operate in the presence of complex situations, technical uncertainties and incomplete information;
- Ability to initiate changes in professional environment and to develop new initiatives or establish enterprises, organizations, companies, associations, etc.

Content

This course will introduce students to the basic concepts of the circular economy. The course addresses the innovative solutions for the circular economy taking into account technical consideration and business model design. For that purpose, a LCA as a tool of better informing decision-makers is used.
Each lesson consists roughly of 1 hour lecture and 1 hour practice/exercises

Lesson 1	Context analysis	No specific equipment required
Lesson 2	Project background	No specific equipment required
Lesson 3	Environment/external forces	No specific equipment required
Lesson 4	Conduct study /situational analysis	Drone is to be used to conduct aerial surveys of buildings to assess external environmental factors affecting energy efficiency, such as sun exposure, wind patterns, and insulation effectiveness
Lesson 5	SWOT analysis	Desktops/laptops
Lesson 6	Stakeholder Analysis	Desktops/laptops
Lesson 7	Problem Analysis	Desktops/laptops
Lesson 8	Objective Analysis	Desktops/laptops
Lesson 9	Plan of activities	Desktops/laptops
Lesson 10	Resource/inputs planning	Desktops/laptops

	Lesson 11	Indicators/measurment of objectives	Desktops/laptops
	Lesson 12	Analysis of assumptions and risks	Desktops/laptops
	Lesson 13	Risk analysis and management	Desktops/laptops
	Lesson 14	Research methods in using renewable energy and energy efficiency projects	Desktops/laptops
	Lesson 15	Data Collection: approaches, methods and Techniques in projects concerning energy efficiency	Desktops/laptops
	Lesson 16	Data Collection: Secondary resources Research and desk study on renewable energy and energy efficiency depending on the selected project.	Desktops/laptops
	Lesson 17	The role of consulting companies in energy management	Desktops/laptops
	Lesson 18	Analyzing Data and monitoring in long term projects for securing energy sustainability and resilience	G-ISBEM software interface license, to be used by students for long-term data analysis and monitoring of energy consumption.
	Lesson 19	Action Research – field study and measuring on existing construction sites different categories for the energy efficiency	Thermal Imaging Camera and Thermal Imaging Camera with Moisture Meter to be used for on-site measurements of temperature variations and moisture levels, identifying issues with insulation and leaks that impact energy efficiency.
	Lesson 20	Data processing and presenting-development of optimal data presentation to secure understanding and importance of energy savings and sustainable resource management in construction and industry.	Desktop/laptop computers to run data visualization software (such as Excel, MATLAB, or specialized energy management software such as G-ISBEM).
Methodology	**Learning Evaluation Methods**. All candidates dedicate themselves to the *Study Development* (group work) and to the *Project Retrospective Report* (individual work). They will be guided by the professor who		

will introduce all aspects of the project and analyze and discuss all issues emerging during the semester project implementation. The discussion will be held once a week, in the form of exercises. Therefore, all activities in the project refer to both individual and teamwork, and the final output implies the desk study that should be presented to respective professors by all group members.
Working in groups and dedicating themselves to the study answers, the participants create and develop the study structure, which in the final instance will represent the learning output of all group members. An interdisciplinary project in this regard envelops the multiple learning objectives from different courses, extended knowledge, and multi-corner application of the research methods. They have to research and present the knowledge obtained through the written analysis and recommendation.
After two weeks of preparation the students' groups will submit:

- team composition and organogram
- problem Statement for the research
- Logical Framework and Ghant Diagram of their proposed activities

After the completion of the semester the students will submit the Final report and Semester Project.

Learning Evaluation Criteria

Written part

Description	**Allocation of points**	**Estimate**	**Total**
Issue related to concrete project task	Complexity- justification/ background/intro/value Problem statement/delimitation Link theory with practical problem	5 5 5	15
Structure and Formatting	Use reliable sources and references Proper use of tables, figures and graphics Language and executive summary	5 5 5	15
Key issues within area of study and good use of programme subjects	Critical analysis of source materials Depth comparative of analysis Correction between the problem statement and conclusions Independent thinking and analysis	5 5 5 5	20
Total			
Grade			

Oral presentation

Description	**Allocation of points**	**Grade Equivalent**	**Out of 100%**
Excellent presentation • An outstanding presentation indicating evidence of wide knowledge and understanding of the subject. • Mastering of the topic with confidence while providing detailed and accurate relevant information.	For an excellent performance	12	100

	• Clear evidence or research and preparation. • Strong and structured arguments based on concise and persuasive approach. • Maintaining eye contact while focusing on attention and interest • Clear and loud speech • Questions answered to with courtesy and authority • Positive body language, formal dressing code and appropriate appearance • Use of appropriate grammar and vocabulary, demonstrating high English language proficiency • Excellent PPT presentation and its layout			
	Very Good Presentation • An excellent presentation indicating evidence of wide knowledge and understanding of the subject. • Very good explanation of the topic with fair confidence • Mastering of the topic with confidence while providing easily understood information • Providing compelling evidence for selected ideas • Actively engages and communicates with the audience • Appropriate use of dressing code and appropriate appearance • Uses appropriate grammar and vocabulary with good English language proficiency • Good PPT presentation layout	For a very good performance	10	90
	Good Presentation • The audience can understand the topic/ subject matter • Reasonable justification of ideas based on arguments • Some evidence of outside reading but mainly based on the key tasks. • Insufficient analysis and evaluation • Active engagement and communicates with the audience • Appropriate use of dressing code and appropriate appearance • A competent answer showing sound knowledge and while relating to particular theories and concepts	For a good performance	7	80

	• Uses appropriate grammar and vocabulary with adequate English language proficiency • Good PPT presentation layout			
	Fair Presentation • Demonstrating a reasonable knowledge but lacking depth of understanding • Presenting the topic so the audience can understand it • Heavy reliance on class materials with no evidence of outside reading • Weak or no evidence of analysis and evaluation • Actively engages and communicates well with audience • Appropriate dressing code and appropriate appearance • Some errors in presentation are evident • Uses appropriate grammar and vocabulary with adequate English language proficiency • Satisfactory presentation layout	For a fair performance	4	70
	Bare Pass Presentation • Presenting the topic so the audience can barely guess the subject matter • Mentions some relevant points but lacks focus on the question • No evidence of reading or using other sources but the class material • Notable error s ad omissions • Hardly answers the questions related to the subject matter • Weak presentations and its structure, poorly presented and not easy to follow.	For low performance	2	55
	Inadequate presentation • Notably Poor presentation skills • Unable to demonstrate the minimum understanding of the subject matter • Substantial omission and errors in presentation No presentation skills and confusion • Poor introduction of the topic with no relevance • Time limits ignored • Contains evident fundamental errors and misunderstanding • Unable to answer questions • Poor English language proficiency • Clumsy presentation layout	For inadequate performance	0	0-54

Plagiarism, Cheating or Non submission of the required task	Academic offence or no work done at all	-03	NA

Learning Measurement Criteria

Performance	Excellent	Very good	For a good	Fair	Adequate	Inadequate	
Grading Percentage	> 95%	85% - 95%	75% - 85%	65% - 74%	55% - 64%	< 55%	No Exam / Plagiarism
Grade according to the ECTS Credit System	A	B	C	D	E	Fx	F
IBCM Grade	12	10	7	4	2	0	-3

Final Mark Allocation Criteria

Final Exam – 50%
Oral defense – 50%

Bibliography

The following are the recommended readings for this course. The required reading for each class will be posted on Google classroom one week before lectures.

- Research Methods in Management, Geoff Lancaster, 2005

Educational resources

Laboratory for Environmental Management and Energy Management
1 Thermal imaging camera.
1 Bench multimeter
1 Bench power supply
1 Thermal Imaging Moisture Meter
1 Drone for analysing buildings envelope from an energy efficiency point of view.
5 Desktop computers able to run software for simulation.
2 Laptop computers able to run software for simulation.
1 G-ISBEM software interface license.
Sima Pro software license

Institution	International Business College Mitrovica
Module (Title)	**RENEWABLE ENERGY**
Full Name of the Professor	Damir Gashi
Hours:	20 hrs lectures + 20 hrs practice (exercises, etc) 110 hrs student workload 150 hrs total
Program	- Bachelor Degree in Environmental and Agricultural Management - 5 ECTS - 4th semester (2nd year of the study program), 2024/2025 - mandatory
Learning outcomes	**Knowledge and understanding** Students will acquire knowledge and understanding: • of mathematics, sciences and engineering disciplines underlying specialization to solve/design/investigate/conduct complex engineering problems/products, processes and systems/issues/activities; • of the green energy – what types exist and how does it work • of general financial considerations to implement green energy projects • of the difficulties in exchanging fossil fuels with renewable energy sources • of the economic, organizational and managerial aspects (such as project management, risk and change management) of business contexts in exchanging fossil fuels with renewable energy sources; **Capacity in applying knowledge and understanding:** • Ability to compare Renewable Energy Sources for proposing a new and applicable combination of energy sources in a local community or larger industry; • Ability to compare and analyze the advantages or limitations, and costs of different renewable energy sources; • Ability to identify and use renewable sources such as the sun, wind, biomass, geothermal resources, and water for sustainable energy generation; • Capacity to apply theoretical knowledge to real-world scenarios, proposing, developing, and assessing sustainable energy projects; • Ability to interpret and use data related to energy production, and efficiency in decision-making processes; • Ability to apply the principles of sustainability and the role of renewable energy in promoting sustainable development; • Ability to develop and implement projects that meet defined and specified requirements, applying appropriate design methodologies.

	Transversal skills: • Ability to engage in independent lifelong learning and to follow developments in science and technology and undertake further studies in new and emerging technologies.
Content	The course explains the fundamentals of energy, including the transfer of energy, as well as the limitations of natural resources. It is conceived to provide an insight in the utilization of resources in designing and construction of energy saving facilities and buildings. It gives introduction to renewable Energy include Photovoltaic, Wind power, Micro hydropower, Biomass energy, Waste power, Solar thermal power, Geothermal power, Ocean energy (tidal, tide-flow and wave), Ocean energy (OTEC). Comparison of characteristics and cost of renewables. How we can use the sun, wind, biomass, geothermal resources, and water to generate more sustainable energy.

Lesson 1	Energy sources: fossil fuels	Desktops/laptops
Lesson 2	Energy sources: wind, solar and hydro	Desktop Computers to run software for designing and optimizing solar panels calculations (https://base.k2-systems.com/#/dashboard), wind turbine design, simulation and certification
Lesson 3	Energy sources: chemical energy sources/batteries	Bench multimeter to measure battery voltage, current, and resistance, essential for understanding battery performance and energy storage in chemical sources
Lesson 4	Case work	No specific equipment required
Lesson 5	Energy sources: biogas	Desktops/laptops
Lesson 6	Case work – how to start a biogas plant (location, "fuels", economy e.g.)	No specific equipment required
Lesson 7	Energy sources: biofuel (willow, wood chips, e.g.)	No specific equipment required
Lesson 8	Energy sources: bio-ethanol (1st and 2nd generation)	No specific equipment required
Lesson 9	Alternative energy sources • Geothermal energy • Tide energy • Fusion energy	Desktop computers to run software and browse the internet sources on various forms of energy

			simulations and building energy analysis (EnergyPlus, OpenModellica, QBlade, Fusion Evaluator, etc)
	Lesson 10	Energy efficiency in: • Energy production • Energy consumption	Thermal imaging camera and Thermal imaging camera Moisture Meter to analyze energy efficiency through the detection of heat and moisture, their patterns, and loss in the buildings.
	Lesson 11	Solar termal facilities: Overview. Introduction to solar thermal facilities, focusing on their general structure and operational schemes, and the integration of solar thermal energy into the construction of energy-efficient buildings. • Basics of solar thermal systems • Schematics of solar thermal facilities • Applications in residential and commercial buildings	Desktop computers able to run software for simulation Simulation software like an online model for designing and optimizing solar panels calculations (https://base.k2-systems.com/#/dashboard) on the effectiveness and integration of solar thermal systems in residential and commercial buildings
	Lesson 12	Solar Radiation and Shadows: Impact on Building Energy Efficiency. • Understanding solar radiation • The effect of shadows on energy efficiency • Techniques for optimizing energy efficiency in buildings	Drone will to capture aerial footage of buildings, and analyze the effects of shadows on energy efficiency from the aerial footage.
	Lesson 13	Energy Saving Methods in Buildings. Traditional and modern energy-saving methods. Analysis of material efficiency and new tehcnologies	Sima PRO software
	Lesson 14	Energy Storage Solutions in Building Design. • Overview of energy storage technologies (batteries, thermal storage, etc.) • Integration of energy storage in building design • Case studies of energy storage in residential and commercial buildings	Bench power supply

Lesson 15	Digitalization in Control and Regulation Subsystems for Energy Efficiency • Digitalization in energy management • New technologies in control systems • Digitalized energy-efficient buildings (example IoT)	Desktops and laptops to be used for simulations of IoT (Arduino, Raspberry PI, NodeMCU) and digitalized energy management systems
Lesson 16	Monitoring and Optimization of Energy Efficiency in Buildings . • Monitoring energy consumption in real-time • Optimization techniques for existing building systems • Application of digital tools in energy management	G-ISBEM software for modelling and monitoring energy efficiency in real-time, optimizing building systems
Lesson 17	Photovoltaic systems • Components of photovoltaic systems • Sizing and optimization of PV installations • New materials in PV systems in building design Detailed exploration of isolated photovoltaic (PV) systems, including their components, sizing, and material optimization for energy-efficient construction	Bench power supply Bench Multimeter Desktops/laptops
Lesson 18	Heat pump and Geothermal installations as a source of renewable energy in buildings • Basics of heat pump technology • Geothermal energy integration in buildings • Case studies on the application of heat pumps and geothermal systems	Desktop/laptop computers for simulating heat pump systems (Free heat pump calculator | GeoT*SOL online (valentin-software.com)) and geothermal system installations in buildings (HyGCHP Modeling Tool | Slipstream (slipstreaminc.org))
Lesson 19	Installations of small wind turbines. Calculation – usage of small wind turbines in housing – optimization and energy resilience • Basics of small wind turbine technology • Calculating energy production and savings • Integration of wind energy in residential settings	Desktop/laptop .
Lesson 20	Discussion and Final Exam Preparation	

Methodology

Learning Evaluation Methods.

- Participation – student must be present at least 70% of lectures with active participation in discussion
- Compulsory assignment – Topic of the CA shall be selected during the course based on the lessons. List shall be provided by the Lecturer, Students can select the topic from the list of the topic and have for a task to research and present the knowledge obtained through the written analysis and recommendation. Apply calculation methods in the sizing and evaluation of RE facilities in the selected buildings. Use measuring devices applied to the control and verification of the operation of the facilities, as well as handle tools
- Final Exam – It consist of written and oral part

Learning Evaluation Criteria

Written part

Description	**Allocation of points**	**Estimate**	**Total**
Issue related to concrete project task	Complexity- justification/ background/intro/value Problem statement/delimitation Link theory with practical problem	5 5 5	15
Structure and Formatting	Use reliable sources and references Proper use of tables, figures and graphics Language and executive summary	5 5 5	15
Key issues within area of study and good use of programme subjects	Critical analysis of source materials Depth comparative of analysis Correction between the problem statement and conclusions Independent thinking and analysis	5 5 5 5	20
Total			
Grade			

Oral presentation

Description	**Allocation of points**	**Grade Equivalent**	**Out of 100%**
Excellent presentation • An outstanding presentation indicating evidence of wide knowledge and understanding of the subject. • Mastering of the topic with confidence while providing detailed and accurate relevant information. • Clear evidence or research and preparation. • Strong and structured arguments based on concise and persuasive approach. • Maintaining eye contact while focusing on attention and interest	For an excellent performance	12	100

	• Clear and loud speech • Questions answered to with courtesy and authority • Positive body language, formal dressing code and appropriate appearance • Use of appropriate grammar and vocabulary, demonstrating high English language proficiency • Excellent PPT presentation and its layout			
	Very Good Presentation • An excellent presentation indicating evidence of wide knowledge and understanding of the subject. • Very good explanation of the topic with fair confidence • Mastering of the topic with confidence while providing easily understood information • Providing compelling evidence for selected ideas • Actively engages and communicates with the audience • Appropriate use of dressing code and appropriate appearance • Uses appropriate grammar and vocabulary with good English language proficiency • Good PPT presentation layout	For a very good performance	10	90
	Good Presentation • The audience can understand the topic/ subject matter • Reasonable justification of ideas based on arguments • Some evidence of outside reading but mainly based on the key tasks. • Insufficient analysis and evaluation • Active engagement and communicates with the audience • Appropriate use of dressing code and appropriate appearance • A competent answer showing sound knowledge and while relating to particular theories and concepts • Uses appropriate grammar and vocabulary with adequate English language proficiency • Good PPT presentation layout	For a good performance	7	80
	Fair Presentation • Demonstrating a reasonable knowledge but lacking depth of understanding	For a fair performance	4	70

	• Presenting the topic so the audience can understand it • Heavy reliance on class materials with no evidence of outside reading • Weak or no evidence of analysis and evaluation • Actively engages and communicates well with audience • Appropriate dressing code and appropriate appearance • Some errors in presentation are evident • Uses appropriate grammar and vocabulary with adequate English language proficiency • Satisfactory presentation layout			
	Bare Pass Presentation • Presenting the topic so the audience can barely guess the subject matter • Mentions some relevant points but lacks focus on the question • No evidence of reading or using other sources but the class material • Notable error s ad omissions • Hardly answers the questions related to the subject matter • Weak presentations and its structure, poorly presented and not easy to follow.	For low performance	2	55
	Inadequate presentation • Notably Poor presentation skills • Unable to demonstrate the minimum understanding of the subject matter • Substantial omission and errors in presentation No presentation skills and confusion • Poor introduction of the topic with no relevance • Time limits ignored • Contains evident fundamental errors and misunderstanding • Unable to answer questions • Poor English language proficiency • Clumsy presentation layout	For inadequate performance	0	0-54
	Plagiarism, Cheating or Non submission of the required task	Academic offence or no work done at all	-03	NA
	Learning Measurement Criteria			

Performance	Excellent	Very good	For a good	Fair	Adequate	Inadequate	
Grading Percentage	> 95%	85% - 95%	75% - 85%	65% - 74%	55% - 64%	< 55%	No Exam / Plagiarism
Grade according to the ECTS Credit System	A	B	C	D	E	Fx	F
IBCM Grade	12	10	7	4	2	0	-3

Final Mark Allocation Criteria
Participation 10%
Compulsory assignment –30%
Final Exam – 60% (50% for written part and 50% for oral part)

Bibliography

The following are the recommended readings for this course.

- Wright, Richard T.: Environmental Science, Toward a Sustainable Future Chapter 19, 20, 22 http://agrotech.dk/en
- Wright, Richard T.: Environmental Science, Toward a Sustainable Future, Chapter 14 www.green-technology.org/https://www.elaw.org/files/mining-eia-guidebook/Chapter1.pdf
- Wright, Richard T.: Environmental Science, Toward a Sustainable Future. Chapter 14 http://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html www.geointeractive.co.uk/.../environmental%20impact%20of%20tou...www.wasteless.com http://www.copenhagenconsensus.com/Research/Index/Climate%20Change%20-%20Energy.aspx
- Wright, Richard T.: Environmental Science, Toward a Sustainable Future Chapter 16 Renewable energy http://www.alternative-energy-news.info/technology/battery-power/
- BIAS Bio energy Environmental Impact Analysis –Analytical Framework
- Wright, Richard T.: Environmental Science, Toward a Sustainable Future Chapter 16 Renewable energy http://www.alternative-energy-news.info/technology/
- The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy, Bill Prindle and Maggie Eldridge, American Council for an Energy-Efficient Economy, Mike Eckhardt and Alyssa Frederick, American Council on Renewable Energy

Educational resources

Laboratory for Environmental Management and Energy Management
1 Thermal imaging camera.
1 Bench multimeter
1 Bench power supply
1 Thermal Imaging Moisture Meter
1 Drone for analysing buildings envelope from an energy efficiency point of view.
5 Desktop computers able to run software for simulation.

	2 Laptop computers able to run software for simulation. 1 G-ISBEM software interface license. Sima Pro software license

Institution	International Business College Mitrovica
Module (Title)	**ADVANCED NATURAL RESOURCES MANAGEMENT**
Full Name of the Professor	Ekrem Gjokaj
Hours:	20 hrs lectures + 20 hrs practice (exercises, etc) 110 hrs student workload 150 hrs total
Program	- Master Degree in International Management and Leadership, specialization Environmental Management - 5 ECTS - 3rd semester (2nd year of the study program) 2024/2025 - mandatory
Learning outcomes	**Knowledge and understanding** Students will acquire knowledge to: • effectively define the key ecological principles that underlie natural resource management; • define realistic objectives to assess or solve a problem or issue; • assess roles of various stakeholders as they relate to natural resource management; • develop and explain a step-by-step process of implementing a plan on the use of natural resource management in the broader context of sustainability, climate change, and ecosystem health; and the holistic understanding of the concepts of sustainability and resilience. **Capacity in applying knowledge and understanding:** • Apply key concepts in the field of natural resource management for problem solving across a range of contexts; • Synthesize and critically analyze information from the primary literature and other sources; • Ability to independently research the sustainability and resilience of the environment at different levels; • Ability to conduct analyzes, experiments, assessments and evaluations, as well as the ability to synthesize and interpret results and formulate conclusions,; • Ability to develop projects which sustain good quality and rationally uses natural resources (energy, raw materials, water and land); **Transversal skills:** • Communicate information and present them through written or oral modes; • Ability to initiate changes in professional environment and to develop new initiatives or establish enterprises, organizations, companies, associations, etc.

Content

This course covers key issues associated with managing natural resources in a sustainable way and balancing human demand with the need to maintain ecological integrity. The course will review basic ecological principles that underpin natural resource management 1) problems associated with the use/misuse of our natural resources and 2) current management practices associated with the conservation of natural resources. A study project approach will be employed to demonstrate theory in practice.

Lesson 1	Introduction to Natural Resource Bases: Part 1 Concept of resources, Environmental resources, Potential values of environmental resources- real and external values. Classification of resources: exhaustible- renewable, partly renewable and non-renewable and inexhaustible- conditionally inexhaustible.	90 mins lesson theory
Lesson 2	Major uses of natural resources: Carrying capacities, ecological footprint and sustainability; Sustainable portfolios, Building sustainable business. Natural resources of different regions. Exercise: Limiting factors for carrying capacities, Exercise: Carrying capacity K for particular species, population or community: field trip and formulation of population growth curves.	90 mins lesson theory. 90 mins field trip and outdoor exercise
Lesson 3	Ecological footprint: Demand and Supply of Nature. Sustainable Resource Management Paradigms	90 mins lesson theory
Lesson 4	Approaches in Resource Management Natural resources concept: Preservation and Conservation Land resources, Water resources, Mineral resources, Power resources The evaluation of the power resources in the region of Mitrovica	90 mins lesson theory. 90 mins field trip and outdoor exercise 50% modified
Lesson 5	Biodiversity and conservation of natural resources. Exercise: Biodiversity evaluation in the local plot, Environmental Management laboratory	90 mins field trip and outdoor exercise
Lesson 6	Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA): Resource allocation, Resource development, Resource management and resource conservation paradigms of environmental management and development: individual factors, socio-economics factors, political-economic factors, institutional factors	90 mins lesson theory
Lesson 7	Community-based Natural Resource Management or CBNRM- the focus on the collective management of ecosystems to improve human well-being. How CBNRM creates the right incentives and conditions	90 mins lesson theory. Discussion w. stakeholder, analysis in the building sector

	for an identified group of resource users within defined areas to use natural resources sustainably.	
Lesson 8	Technologies for NRM: renewable energy, quantum computing, automation, and artificial intelligence (AI) and singularity.	90 mins lesson theory. IT laboratory
Lesson 9	Field Trip for Case study on Resources management- trip to the construction company – Lin project – analysis on sustainable resource management in building construction	4x90 mins, introduction with the company and setting problem statement for the semester project
Lesson 10	Modeling tools and ICT for NRM. Using modeling tools to model and simulate of usage of resources and energy saving in construction of residential buildings	90 mins Exercise and IT lab
Lesson 11	Energy and Natural Resources Policy - municipal energy efficiency plans, promotion and activities for more energy resilience trough industry and construction	90 mins, workshop on Promotion of energy efficiency plans
Lesson 12	Advanced building technologies Utilization of digital technologies in resource management and energy savings in civil engineering and business	90 mins theory and exercises in IT lab
Lesson 13	Energy Efficiency in Building Sector What are potentials in energy savings in buildings sector Energy-efficient materials Usage of new and old energy efficient materials and potentials in energy savings in building sector Plastic and Aluminum framing vs wooden frames, comparison	90 mins theory and exercise Environmental Management laboratory, Thermal imaging cameras plots, SIMAPro
Lesson 14	Smart cities Utilising a variety of electronic methods and sensors to collect specific data on monitoring of efficiency in urban area – pollution and sustainable resource management in urban areas	90 mins exercise Air quality test unit at IBCM, for the records on PM10, PM2.5 and SO2, NOx, AERMODE software, CALPUFF software in the region of the students interest
Lesson 15	Policies, market instruments and private sector efforts to implement sustainable NRM in Building industry	90 mins of theory

		Current national and regional governmental support in energy savings and applications in energy efficiency grant schemes	

Methodology

Learning Evaluation Methods.

- Participation – student must be present at least 70% of lectures with active participation in discussion
- Compulsory assignment – topic of the CA shall be selected during the course based on the lessons. List shall be provided by the Lecturer, Students can select the topic from the list of the topic and have for a task to research and present the knowledge obtained through the written analysis and recommendation.
- Final Exam – It consist of written and oral part

Learning Evaluation Criteria

Written part

Description	Allocation of points	Estimate	Total
Issue related to concrete project task	Complexity- justification/ background/intro/value Problem statement/delimitation Link theory with practical problem	5 5 5	15
Structure and Formatting	Use reliable sources and references Proper use of tables, figures and graphics Language and executive summary	5 5 5	15
Key issues within area of study and good use of programme subjects	Critical analysis of source materials Depth comparative of analysis Correction between the problem statement and conclusions Independent thinking and analysis	5 5 5 5	20
Total			
Grade			

Project presentation

Description	Allocation of points	Grade Equivalent	Out of 100%
Excellent presentation • An outstanding presentation indicating evidence of wide knowledge and understanding of the subject. • Mastering of the topic with confidence while providing detailed and accurate relevant information. • Clear evidence or research and preparation. • Strong and structured arguments based on concise and persuasive approach. • Maintaining eye contact while focusing on attention and interest	For an excellent performance	12	100

	• Clear and loud speech • Questions answered to with courtesy and authority • Positive body language, formal dressing code and appropriate appearance • Use of appropriate grammar and vocabulary, demonstrating high English language proficiency • Excellent PPT presentation and its layout			
	Very Good Presentation • An excellent presentation indicating evidence of wide knowledge and understanding of the subject. • Very good explanation of the topic with fair confidence • Mastering of the topic with confidence while providing easily understood information • Providing compelling evidence for selected ideas • Actively engages and communicates with the audience • Appropriate use of dressing code and appropriate appearance • Uses appropriate grammar and vocabulary with good English language proficiency • Good PPT presentation layout	For a very good performance	10	90
	Good Presentation • The audience can understand the topic/ subject matter • Reasonable justification of ideas based on arguments • Some evidence of outside reading but mainly based on the key tasks. • Insufficient analysis and evaluation • Active engagement and communicates with the audience • Appropriate use of dressing code and appropriate appearance • A competent answer showing sound knowledge and while relating to particular theories and concepts • Uses appropriate grammar and vocabulary with adequate English language proficiency • Good PPT presentation layout	For a good performance	7	80
	Fair Presentation • Demonstrating a reasonable knowledge but lacking depth of understanding	For a fair performance	4	70

• Presenting the topic so the audience can understand it • Heavy reliance on class materials with no evidence of outside reading • Weak or no evidence of analysis and evaluation • Actively engages and communicates well with audience • Appropriate dressing code and appropriate appearance • Some errors in presentation are evident • Uses appropriate grammar and vocabulary with adequate English language proficiency • Satisfactory presentation layout			
Bare Pass Presentation • Presenting the topic so the audience can barely guess the subject matter • Mentions some relevant points but lacks focus on the question • No evidence of reading or using other sources but the class material • Notable error s ad omissions • Hardly answers the questions related to the subject matter • Weak presentations and its structure, poorly presented and not easy to follow.	For low performance	2	55
Inadequate presentation • Notably Poor presentation skills • Unable to demonstrate the minimum understanding of the subject matter • Substantial omission and errors in presentation No presentation skills and confusion • Poor introduction of the topic with no relevance • Time limits ignored • Contains evident fundamental errors and misunderstanding • Unable to answer questions • Poor English language proficiency • Clumsy presentation layout	For inadequate performance	0	0-54
Plagiarism, Cheating or Non submission of the required task	Academic offence or no work done at all	-03	NA

Learning Measurement Criteria

	<table><tr><td>Performance</td><td>Excellent</td><td>Very good</td><td>For a good</td><td>Fair</td><td>Adequate</td><td>Inadequate</td><td></td></tr><tr><td>Grading Percentage</td><td>> 95%</td><td>85% - 95%</td><td>75% - 85%</td><td>65% - 74%</td><td>55% - 64%</td><td>< 55%</td><td>No Exam / Plagiarism</td></tr><tr><td>Grade according to the ECTS Credit System</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>Fx</td><td>F</td></tr><tr><td>IBCM Grade</td><td>12</td><td>10</td><td>7</td><td>4</td><td>2</td><td>0</td><td>-3</td></tr></table> **Final Mark Allocation Criteria** Participation 10% Compulsory assignment –30% Final Exam – 60% (50% for written part and 50% for oral part)
Bibliography	The following are the recommended readings for this course. The required reading for each class will be posted on Google classroom one week before lectures. • Alexander, Mike (2008). Management Planning for Nature Conservation, Springer. • Ausden, Malcolm (2007). Habitat Management for Conservation, Oxford University Press. • Fabricius, Christo. (2007). Community-based natural resource management: Governing the commons. Water Policy. 9. 83. 10.2166/wp.2007.132. • Wright, T. Richard T. Environmental Science, Toward a Sustainable Future
Educational resources	In the field trips there will be a research conducted on the use of sustainable resources management in the region. The students will use the data collected from the air quality test unit at IBCM, for the records on PM10, PM2.5 and SO2, NOx and from the Monitoring units within the range of national Thermal Electric Power Plant. The student will analyze the air pollution from the energy sector and calculate the benefits of using renewable energy and energy efficiency from the environmental point of view. The simulations will be performed by using AERMOD and CALPUFF software Microcontroller - NodeMCU/ESP8266 Air quality sensor - Nova SDS 011 Laser PM2.5 All the following purchased within the reZEB project: 1 Bench multimeter 1 Bench power supply 1 Thermal imaging camera. 1 Thermal Imaging Moisture Meter 1 Drone for analysing buildings envelope from an energy efficiency point of view. 5 Desktop computers able to run software for simulation. 2 Laptop computers able to run software for simulation. 1 G-ISBEM software interface license For the Assessment of the efficiency of the electricity unit production on environment a SIMA Pro design software will be used.

MODULE: ENERGY MANAGEMENT

Institution	International Business College Mitrovica
Module (Title)	**ENERGY MANAGEMENT**
Full Name of the Professor	Prof.dr. Jelena Djokic
Hours:	20 hrs lectures + 20 hrs practice (exercises, etc) 110 hrs student workload 150 hrs total
Program	- Master degree in International Management and Leadership - 5 ECTS / New module - 3rd semester (2nd year of the study program), 2025/2026. - Elective
Learning outcomes	**Knowledge and understanding** Students will acquire knowledge and understanding: • of general financial considerations in terms of implementing green energy; • of the economic, organizational and managerial aspects (such as project management, risk and change management) of business contexts in energy management systems; **Capacity in applying knowledge and understanding:** • Ability to apply knowledge and understanding of sciences and management disciplines underlying specialization to investigate complex energy issues; • Ability to compare Renewable Energy Sources for proposing a new and applicable combination of energy sources in buildings; • Ability to compare and analyze the advantages or limitations, and costs of different energy use in buildings • Capacity to apply theoretical knowledge to real-world scenarios, proposing, developing, and assessing sustainable energy projects in buildings • Ability to interpret and use data related to energy production, use and efficiency in decision-making processes • Ability to apply the principles of sustainability and the role of renewable energy in promoting sustainable development; • Ability to develop and implement projects that meet defined and specified requirements, applying appropriate design methodologies; • Ability to a new and applicable combination of energy sources in a local community or larger industry. **Transversal skills:** • Ability to engage in independent lifelong learning and to follow developments in science and technology and undertake further studies in new and emerging technologies.

Content

This course will introduce students to the basic concepts of the circular economy. The course addresses the innovative solutions for the circular economy taking into account technical consideration and business model design. For that purpose, a LCA as a tool of better informing decision-makers is used.

Lesson 1	Definition & Objectives of Energy Management
Lesson 2	Energy Audit
Lesson 3	Understanding Energy Costs
Lesson 4	Matching Energy Usage to Requirement
Lesson 5	Maximizing System Efficiency
Lesson 6	Fuel and Energy Substitution
Lesson 7	Energy use in buildings: Physical principles. The thermal envelope of the building and the role of shape, size and orientation. Heating and cooling and their systems
Lesson 8	Energy saving in new advanced buildings and the role of the design process in energy conservation in buildings. Energy saving in existing buildings through restructuring type interventions.
Lesson 9	The concept of "Green" buildings. Energy performance of buildings. Concept for buildings "Nearly zero energy". Use of renewable energy in buildings
Lesson 10	Material and energy balances at process and plant level: Plant as an energy system; Methods for preparing flow charts in processes, balance of masses and energy
Lesson 11	Energy monitoring and targeting: Definition of monitoring-targeting, elements of monitoring-targeting, analysis of data and information, dependence "Energy consumption - Production volume"
Lesson 12	Evaluation of energy performance of utility thermal equipment in industry: Thermal insulation and refractory materials.
Lesson 13	Energy management systems and standards: ISO 50001
Lesson 14	Economic evaluation of measures to improve energy efficiency
Lesson 15	Techniques for financial analysis: simple payback period, return on investment, net present value, internal rate of return, cash flows, risk analysis and sensitivity
Lesson 16	Energy performance contracts and the role of ESCOs.
Lesson 17	Energy and the environment

	Lesson 18	Environmental impact of Energy production, energy use and energy storage
	Lesson 19	Simulation and comparison of the environmental impact from different energy courses
	Lesson 20	Reflection and discussion

Methodology

Learning Evaluation Methods.

- Participation – student must be present at least 70% of lectures with active participation in discussion
- Compulsory assignment – topic of the CA shall be selected during the course based on the lessons. List shall be provided by the Lecturer, Students can select the topic from the list of the topic and have for a task to research and present the knowledge obtained through the written analysis and recommendation. Apply calculation methods in the sizing and evaluation of RE facilities in the selected buidings. Use measuring devices applied to the control and verification of the operation of the facilities, as well as handle tools.
- Final Exam – It consist of written and oral part

Learning Evaluation Criteria

Written part

Description	**Allocation of points**	**Estimate**	**Total**
Issue related to concrete project task	Complexity- justification/ background/intro/value Problem statement/delimitation Link theory with practical problem	5 5 5	15
Structure and Formatting	Use reliable sources and references Proper use of tables, figures and graphics Language and executive summary	5 5 5	15
Key issues within area of study and good use of programme subjects	Critical analysis of source materials Depth comparative of analysis Correction between the problem statement and conclusions Independent thinking and analysis	5 5 5 5	20
Total			
Grade			

Project presentation

Description	**Allocation of points**	**Grade Equivalent**	**Out of 100%**
Excellent presentation • An outstanding presentation indicating evidence of wide knowledge and understanding of the subject.	For an excellent performance	12	100

	• Mastering of the topic with confidence while providing detailed and accurate relevant information. • Clear evidence or research and preparation. • Strong and structured arguments based on concise and persuasive approach. • Maintaining eye contact while focusing on attention and interest • Clear and loud speech • Questions answered to with courtesy and authority • Positive body language, formal dressing code and appropriate appearance • Use of appropriate grammar and vocabulary, demonstrating high English language proficiency • Excellent PPT presentation and its layout			
	Very Good Presentation • An excellent presentation indicating evidence of wide knowledge and understanding of the subject. • Very good explanation of the topic with fair confidence • Mastering of the topic with confidence while providing easily understood information • Providing compelling evidence for selected ideas • Actively engages and communicates with the audience • Appropriate use of dressing code and appropriate appearance • Uses appropriate grammar and vocabulary with good English language proficiency • Good PPT presentation layout	For a very good performance	10	90
	Good Presentation • The audience can understand the topic/ subject matter • Reasonable justification of ideas based on arguments • Some evidence of outside reading but mainly based on the key tasks. • Insufficient analysis and evaluation • Active engagement and communicates with the audience • Appropriate use of dressing code and appropriate appearance	For a good performance	7	80

	• A competent answer showing sound knowledge and while relating to particular theories and concepts • Uses appropriate grammar and vocabulary with adequate English language proficiency • Good PPT presentation layout			
	Fair Presentation • Demonstrating a reasonable knowledge but lacking depth of understanding • Presenting the topic so the audience can understand it • Heavy reliance on class materials with no evidence of outside reading • Weak or no evidence of analysis and evaluation • Actively engages and communicates well with audience • Appropriate dressing code and appropriate appearance • Some errors in presentation are evident • Uses appropriate grammar and vocabulary with adequate English language proficiency • Satisfactory presentation layout	For a fair performance	4	70
	Bare Pass Presentation • Presenting the topic so the audience can barely guess the subject matter • Mentions some relevant points but lacks focus on the question • No evidence of reading or using other sources but the class material • Notable error s ad omissions • Hardly answers the questions related to the subject matter • Weak presentations and its structure, poorly presented and not easy to follow	For low performance	2	55
	Inadequate presentation • Notably Poor presentation skills • Unable to demonstrate the minimum understanding of the subject matter • Substantial omission and errors in presentation No presentation skills and confusion • Poor introduction of the topic with no relevance • Time limits ignored • Contains evident fundamental errors and misunderstanding	For inadequate performance	0	0-54

• Unable to answer questions • Poor English language proficiency • Clumsy presentation layout				
Plagiarism, Cheating or Non submission of the required task	Academic offence or no work done at all	-03	NA	

Learning Measurement Criteria

Performance	Excellent	Very good	For a good	Fair	Adequate	Inadequate	
Grading Percentage	> 95%	85% - 95%	75% - 85%	65% - 74%	55% - 64%	< 55%	No Exam / Plagiarism
Grade according to the ECTS Credit System	A	B	C	D	E	Fx	F
IBCM Grade	12	10	7	4	2	0	-3

Final Mark Allocation Criteria
Participation 10%
Compulsory assignment –30%
Final Exam – 60% (50% for written part and 50% for oral part)

Bibliography

The following are the recommended readings for this course.

- Energy management handbook, John Wiley, and Sons - Wayne C. Turner, Blueprint, London 2018.
- Guide to Energy Management, Cape Hart, Turner and Kennedy, Blue Print, London 2021.

Educational resources

Laboratory for Environmental Management and Energy Management
1 Thermal imaging camera.
1 Bench multimeter
1 Bench power supply
1 Thermal Imaging Moisture Meter
1 Drone for analyzing buildings envelope from an energy efficiency point of view.
5 Desktop computers able to run software for simulation.
2 Laptop computers able to run software for simulation.
1 G-ISBEM software interface license.

Institution	International Business College Mitrovica
Module (Title)	**LIFE CYCLE ASSESSMENT**
Full Name of the Professor	Mihone Kerolli Mustafa
Hours:	20 hrs lectures + 20 hrs practice (exercises, etc) 110 hrs student workload 150 hrs total
Program	- Master Degree in International Management and Leadership - 5 ECTS / New module - 3rd semester (2nd year of the study program) 2025/2026 - elective
Learning outcomes	**Knowledge and understanding** Students will acquire knowledge and understanding: • of the principles and ideas behind the Circular Economy; • of business models that are conducive to a Circular Economy, and the barriers and opportunities for transitioning to these circular business models; • of applicable techniques and methods and their limitations; • on how to create products that are easy to repair, remanufactured or recycle in buildings • . **Capacity in applying knowledge and understanding:** • Ability to choose appropriate techniques and methods in LCA of the constituency of renewable energy installations and building materials; • Ability to recognize ethical and social responsibilities when performing a reliable and transparent LCA to make informed decision for environmental sustainability • Ability to design and conduct analytical investigations, through modeling and experimental, critically evaluate data and draw conclusions; • Ability to design solutions to unfamiliar problems, which may involve other disciplines, and to operate in the presence of complex situations, technical uncertainties and incomplete information; • Ability to apply the principles of sustainability and the role of renewable energy in promoting sustainable development; • Ability to develop and implement projects that meet defined and specified requirements, applying appropriate design methodologies; • Ability to integrate knowledge from different fields and to manage complexity. **Transversal skills:** • Ability to collaborate with various stakeholders;

<table>
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- Ability to engage in independent lifelong learning and to follow developments in science and technology and undertake further studies in new and emerging technologies.

</td></tr>
<tr><td>Content</td><td>

This course will introduce students to the basic concepts of the circular economy. The course addresses the innovative solutions for the circular economy taking into account technical consideration and business model design. For that purpose, a LCA as a tool of better informing decision-makers is used.

<table>
<tr><td>Lesson 1</td><td>The origins and fundamentals of the circular economy</td><td>90 min theory</td></tr>
<tr><td>Lesson 2</td><td>The drivers and business opportunities</td><td>90 min lecture 45 workshop 45</td></tr>
<tr><td>Lesson 3</td><td>Resource constrains, Technology development, Socio-economic Development</td><td>90 min theory</td></tr>
<tr><td>Lesson 4</td><td>Business Model: (a) the design and manufacturing phase; (b) the use phase; and (c) the value recovery phase. Circular design models in Construction business</td><td>90 min theory</td></tr>
<tr><td>Lesson 5</td><td>Optimal use models in Construction business</td><td>90 min theory</td></tr>
<tr><td>Lesson 6</td><td>Longer lasting products in Construction industry building materials, properties</td><td>90 min lecture</td></tr>
<tr><td>Lesson 7</td><td>Value recovery models in Construction industry, the basics of recycling industry</td><td>90 min theory
Field trip to the construction and demolition waste site and recycling center</td></tr>
<tr><td>Lesson 8</td><td>EU Policy framework/Regulatory trends towards the circular economy</td><td>45 min theory</td></tr>
<tr><td>Lesson 9</td><td>Life Cycle Assessment as a tool for optimal use models in Constructing industry</td><td>90 min theory</td></tr>
<tr><td>Lesson 10</td><td>Life Cycle Assessment: 1. Goal and scope definition, 2. Life Cycle Inventory Analysis (LCI) / Life Cycle Inventory Analysis (LCI) in Buildings, 3. Life Cycle Impact Assessment (LCIA), 4. Life Cycle Interpretation</td><td>90 min theory
90 min exercises</td></tr>
<tr><td>Lesson 11</td><td>Life Cycle Assessment: Project design. Sima Pro Design for building material</td><td>90 min workshops on setting the SimaPro Project for building</td></tr>
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			materials LCA assessment.
	Lesson 12	Life Cycle Assessment: Analysis the production phase of building materials	90 min workshops on setting the SimaPro Project for building materials LCA assessment.
	Lesson 13	Life Cycle Assessment: Analysis a product life cycle for building materials, end of life phase and With and without Recovery phase	90 min workshops on setting the SimaPro Project for building materials LCA assessment.
	Lesson 14	Life Cycle Assessment: Comparison of different building materials	90 min workshops on setting the SimaPro Project for building materials LCA assessment.
	Lesson 15	Life Cycle Assessment: Analysis of solar panels production phase	90 min workshops on setting the SimaPro Project for building materials LCA assessment.
	Lesson 16	Life Cycle Assessment: Analysis of solar panels operational phase	90 min workshops on setting the SimaPro Project for building materials LCA assessment.
	Lesson 17	Life Cycle Assessment: Analysis of solar panels end of life phase with and without Recovery phase	90 min workshops on setting the SimaPro Project for building materials LCA assessment.

	Lesson 18	Circular strategies development and business models with real examples	90 min theory to practice approach
	Lesson 19	Circular strategies development and business models with real examples	90 min theory to practice approach
	Lesson 20	Reflection on the results	90 min discussion

Methodology

Learning Evaluation Methods.

- Participation – student must be present at least 70% of lectures with active participation in discussion
- Compulsory assignment – topic of the CA shall be selected during the course based on the lessons. List shall be provided by the Lecturer, Students can select the topic from the list of the topic and have for a task to research and present the knowledge obtained through the written analysis and recommendation.
- Final Exam – It consist of written and oral part

Learning Evaluation Criteria

Written part

Description	**Allocation of points**	**Estimate**	**Total**
Issue related to concrete project task	Complexity- justification/ background/intro/value Problem statement/delimitation Link theory with practical problem	5 5 5	15
Structure and Formatting	Use reliable sources and references Proper use of tables, figures and graphics Language and executive summary	5 5 5	15
Key issues within area of study and good use of programme subjects	Critical analysis of source materials Depth comparative of analysis Correction between the problem statement and conclusions Independent thinking and analysis	5 5 5 5	20
Total			
Grade			

Project presentation

Description	**Allocation of points**	**Grade Equivalent**	**Out of 100%**
Excellent presentation • An outstanding presentation indicating evidence of wide knowledge and understanding of the subject. • Mastering of the topic with confidence while providing detailed and accurate relevant information.	For an excellent performance	12	100

	• Clear evidence or research and preparation. • Strong and structured arguments based on concise and persuasive approach. • Maintaining eye contact while focusing on attention and interest • Clear and loud speech • Questions answered to with courtesy and authority • Positive body language, formal dressing code and appropriate appearance • Use of appropriate grammar and vocabulary, demonstrating high English language proficiency • Excellent PPT presentation and its layout			
	Very Good Presentation • An excellent presentation indicating evidence of wide knowledge and understanding of the subject. • Very good explanation of the topic with fair confidence • Mastering of the topic with confidence while providing easily understood information • Providing compelling evidence for selected ideas • Actively engages and communicates with the audience • Appropriate use of dressing code and appropriate appearance • Uses appropriate grammar and vocabulary with good English language proficiency • Good PPT presentation layout	For a very good performance	10	90
	Good Presentation • The audience can understand the topic/ subject matter • Reasonable justification of ideas based on arguments • Some evidence of outside reading but mainly based on the key tasks. • Insufficient analysis and evaluation • Active engagement and communicates with the audience • Appropriate use of dressing code and appropriate appearance • A competent answer showing sound knowledge and while relating to particular theories and concepts	For a good performance	7	80

	• Uses appropriate grammar and vocabulary with adequate English language proficiency • Good PPT presentation layout			
	Fair Presentation • Demonstrating a reasonable knowledge but lacking depth of understanding • Presenting the topic so the audience can understand it • Heavy reliance on class materials with no evidence of outside reading • Weak or no evidence of analysis and evaluation • Actively engages and communicates well with audience • Appropriate dressing code and appropriate appearance • Some errors in presentation are evident • Uses appropriate grammar and vocabulary with adequate English language proficiency • Satisfactory presentation layout	For a fair performance	4	70
	Bare Pass Presentation • Presenting the topic so the audience can barely guess the subject matter • Mentions some relevant points but lacks focus on the question • No evidence of reading or using other sources but the class material • Notable error s ad omissions • Hardly answers the questions related to the subject matter • Weak presentations and its structure, poorly presented and not easy to follow	For low performance	2	55
	Inadequate presentation • Notably Poor presentation skills • Unable to demonstrate the minimum understanding of the subject matter • Substantial omission and errors in presentation No presentation skills and confusion • Poor introduction of the topic with no relevance • Time limits ignored • Contains evident fundamental errors and misunderstanding • Unable to answer questions • Poor English language proficiency • Clumsy presentation layout	For inadequate performance	0	0-54

Plagiarism, Cheating or Non submission of the required task	Academic offence or no work done at all	-03	NA

Learning Measurement Criteria

Performance	Excellent	Very good	For a good	Fair	Adequate	Inadequate	
Grading Percentage	> 95%	85% - 95%	75% - 85%	65% - 74%	55% - 64%	< 55%	No Exam / Plagiarism
Grade according to the ECTS Credit System	A	B	C	D	E	Fx	F
IBCM Grade	12	10	7	4	2	0	-3

Final Mark Allocation Criteria
Participation 10%
Compulsory assignment –30%
Final Exam – 60% (50% for written part and 50% for oral part)

Bibliography

The following are the recommended readings for this course.

- Stahel, W. R. (2016). The circular economy. Nature, vol. 531, no. 7595, comment. [Available from http://www.nature.com/news/the-circular-economy-1.19594]
- Ellen MacArthur Foundation (2011). Re-thinking progress: The Circular economy. [Available from https://www.youtube.com/watch?v=zCRKvDyyHmI]
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- An Economic And Business Rationale For An Accelerated Transition. [Available from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthurFoundation-To wards-the-Circular-Economy-vol.1.pdf]
- Koppius, O. ÖrÖzdemir-Akyildirim; E. van der Laan (2014). Business Value from Closed-Loop Supply Chains.
- European Environment Agency, Life Cycle Assessment: A guide to approaches, experiences and information sources, Environmental Issues Series 6
- Scientific Applications International Corporation (SAIC), Life cycle Assessment: Principles and Practice, EPA/600/R-06/06, 2006
- Nasr, N.; Thurston, M. (2006). Remanufacturing: A Key Enabler to Sustainable Product Systems. Proceedings of the 13th CIRP International Conference on Life Cycle Engineering, p 15-18. [Available from http://www.mech.kuleuven.be/lce2006/key4.pdf]

Educational resources	Laboratory for Environmental Management and Energy Management 1 SimaPro software (Phd license). 1 SimaPro software (multiple license). 1 G-ISBEM software interface license