

SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Building Services Engineering
1.3	Department	Building Services Engineering
1.4	Field of study	Civil Engineering and Building Services
1.5	Cycle of study	Master
1.6	Program of study/Qualification	Building Services for Regenerative Cities / MS Engineer
1.7	Form of education	Full time

2. Data about the subject

2.1	Subject name	Life Cycle Analysis	Subject code	12.00
2.2	Course responsible/lecturer	Assoc. Prof. PhD. Eng. Dana-Adriana ILUȚIU-VARVARA Adresa de email: dana.adriana.varvara@insta.utcluj.ro		
2.3	Teachers in charge of project	Assoc. Prof. PhD. Eng. Dana-Adriana ILUȚIU-VARVARA Adresa de email: dana.adriana.varvara@insta.utcluj.ro		
2.4	Year of study	1	2.5 Semester	2
2.6	Assessment	Colloquy		
2.7	Subject category	Formative category	DC	
		Optionality	DOB	

3. Estimated total time

3.1	Number of hours per week	3	of which	3.2 Course	2	3.3 Seminar	0	3.3 Laboratory	0	3.3 Project	1
3.4	Total hours in the curriculum	42	of which	3.5 Course	28	3.6 Seminar	0	3.6 Laboratory	0	3.6 Project	14
3.7	Individual study:										
	(a) Exams and tests										30
	(b) Manual, lecture material and notes, bibliography										8
	(c) Supplementary study in the library, online and in the field										18
	(d) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										-
	(e) Tutoring										2
	(f) Other activities										-
3.8	Total hours of individual study (sum (3.7(a)...3.7(f)))					58					
3.9	Total hours per semester (3.4+3.8)					100					
3.10	Number of credit points					4					

4. Pre-requisites (where appropriate)

4.1	Curriculum	-
4.2	Competence	Defining the fundamental concepts necessary for the application of environmental scientific theories and methodology.

5. Requirements (where appropriate)

5.1	For the course	21 December Boulevard, No.128-130, Cluj-Napoca
5.2	For the applications project	21 December Boulevard, No.128-130, Cluj-Napoca

6. Specific competences

Professional competences	CP2 - synthesizes information; CP4 - promotes awareness of environmental issues; CP6 - assesses environmental impact; CP7 - lead a team in water management activities; CP11 - perform water analysis; CP13 - consider the impact of material characteristics on pipeline flows; CP17 - design pipelines with different coating solutions; CP20 - mitigate the environmental impact of pipeline projects; CP21 - combine multiple fields of knowledge; CP23 - advice on building materials; CP25 - manages air quality.
Cross competences	CT1 - collaborating in teams and networks; CT2 - thinks holistically; CT3 - dealing with problems.

7. Expected Learning Outcomes

Knowledge	CP2 - Knows the methods of critical analysis of information sources specific to the urban field (environmental studies, European regulations), synthesis techniques and how to structure complex data to substantiate decisions in urban planning. CP4 - Knows in depth the main urban environmental problems (air, water, soil, noise pollution, heat islands, biodiversity loss), anthropogenic impact on the environment (carbon footprint, resource consumption, waste generation), environmental regulations (European directives, national legislation) and the principles of sustainable development and circular economy. CP6 - Knows the methodologies for assessing environmental impact, urban sustainability indicators (ecological footprint, air quality, urban biodiversity) and the principles of sustainable development in the context of regenerative cities. CP7 - Knows the principles of integrated management of water resources in the urban environment, treatment technologies and European regulations. CP11 - Knows the physicochemical and bacteriological parameters of drinking and wastewater, sampling and analysis methods according to standards, quality requirements for different uses and water resource protection norms. CP13 - Knows the properties of materials used in urban pipelines (PVC, HDPE, ductile iron, steel, composites), interaction with transported fluids, durability in aggressive environments. CP17- Knows the solutions for coating and protecting pipelines depending on the transported fluid and environmental conditions, materials and application technologies. CP20- Knows the methods for assessing and mitigating the environmental impact of pipeline projects (soil protection, waste management, biodiversity protection, emission reduction), environmental regulations and technical solutions for reducing the impact. CP21- Has integrated knowledge from various fields (installation engineering, materials science and engineering, environmental sciences, circular economy), essential for the holistic approach to regenerative cities. CP23- Knows the construction materials used in urban infrastructure (pipes, structures, finishes, sustainable and recycled materials), technical properties, durability, environmental impact and quality standards. CP25- Knows the main air pollutants, air quality standards (European and national norms), monitoring methods (fixed stations, mobile sensors, remote sensing) and pollution reduction measures.
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Skills	CP2 - Critically analyzes environmental impact studies. CP4 - Actively promotes awareness of environmental issues within urban infrastructure projects, provides advice on reducing the impact on environmental factors and promoting sustainable solutions. CP6 - Monitors and evaluates the environmental impact of urban infrastructure projects, develops impact assessment studies, proposes reduction, compensation and monitoring measures, integrates the principles of sustainable development and the circular economy into the proposed solutions. CP7 - Coordinates technical teams in urban water management projects. CP11 - Takes water samples from urban networks and natural sources, uses rapid analysis kits and laboratory equipment, interprets results in relation to quality standards, proposes remedial measures, prepares water quality reports. CP13 – Selects appropriate materials depending on the fluid transported (drinking water, wastewater, thermal agents), operating conditions (pressure, temperature, aggressive environment), projected lifetime and environmental impact, evaluates risks associated with materials (corrosion, wear, leaks) and proposes protection and monitoring solutions. CP17- Designs pipelines with differentiated coating solutions depending on the fluid transported (drinking water, wastewater, thermal agents, gases), environmental conditions (soil corrosivity, fluid aggressiveness) and projected lifetime, chooses materials. CP20- Analyzes the environmental effects of pipeline projects, develops impact management plans, proposes measures to mitigate environmental impact. CP21- Integrates perspectives from multiple disciplines in the analysis and solution of complex urban problems, collaborates effectively with specialists from different fields (architects, urban planners, ecologists, sociologists, economists), develops interdisciplinary solutions that simultaneously respond to technical, social, economic and environmental requirements. CP23- Analyzes technical and environmental requirements for urban infrastructure projects, evaluates material alternatives from a technical, economic and sustainability perspective, provides reasoned recommendations regarding the selection of optimal materials. CP25- Monitors air quality using specific equipment, analyzes the data obtained, identifies pollution sources and trends, assesses compliance with standards, proposes emission reduction measures.
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Responsibilities and autonomy	CP2 - Evaluates information sources independently and forms their own evidence-based opinions in the context of regenerative urban development. CP4 - Acts as a sustainability advocate in urban infrastructure projects, taking responsibility for raising awareness of environmental issues among all stakeholders, promoting best practices and integrating sustainable development principles. CP6 - Coordinates environmental impact assessment processes for complex urban infrastructure projects, taking responsibility for the quality of analyses, for compliance with national and European regulations and for integrating environmental protection measures into technical solutions that shape sustainable urban development. CP7 - Leads interdisciplinary teams in complex urban water management projects. CP11 - Performs analyses according to standardized procedures, accurately records results and reports deviations from acceptable limits. CP13 - Decides on the selection of materials for critical urban pipeline systems, in the context of sustainable urban development and water resource protection. CP17- Decides on protection solutions for critical urban pipelines, in the context of life cycle costs and environmental impact. CP20- Manages environmental impact mitigation processes for complex pipeline projects, taking responsibility for environmental protection in the context of sustainable urban development. CP21 - Addresses the challenges of regenerative urban development from a holistic and integrated perspective, taking responsibility for solutions that harmonize the multiple dimensions of sustainability. CP23 - Acts as an expert in the selection of materials for urban infrastructure, with reduced environmental impact, in the context of circular economy and regenerative urban development. CP25 - Manages air quality monitoring processes in urban projects and recommends methods to improve air quality.
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8. Discipline objectives (as results from the *key competences gained*)

8.1	General objective	Knowledge and deepening of the fundamental principles regarding the analysis of the life cycle of products, in order to minimize the negative impact on the environment. Acquisition of knowledge and development of the necessary skills for the application of the Life Cycle Assessment (LCA) methodology in the assessment of the environmental performance of products, materials, processes and urban infrastructure systems, in order to substantiate decisions regarding sustainable development, efficient use of resources and the implementation of the principles of the circular economy.
8.2	Specific objectives	Training skills in developing an individual study on the life cycle analysis of a product. Applying methods for assessing the environmental impact of all activities associated with a product / process / technological flow, starting from the generation of raw materials and auxiliary materials until its final disappearance. Training practical skills and creating the necessary competencies for making decisions regarding the development of new products and technologies with minimal environmental impact. Knowledge of the principles, stages and standards specific to Life Cycle Analysis (LCA) and its role in assessing the

		sustainability of urban systems. Developing the capacity to collect, analyze and synthesize the data necessary for the life cycle inventory for products / processes / technological flows / materials used in urban infrastructure. Training skills in identifying and assessing the environmental impacts generated during the life cycle of products / processes / technological flows / materials used in urban infrastructure. Developing skills in comparative analysis of technological alternatives and construction and installation materials from the perspective of environmental performance and sustainability. Applying the concepts of circular economy, resource efficiency and carbon footprint reduction in the evaluation and optimization of urban systems. Developing the capacity to interpret the results of life cycle analyses and to formulate recommendations for reducing environmental impact. Developing skills in assessing the environmental performance of water supply, sewage, transport and urban infrastructure systems using specific sustainability indicators. Developing the capacity to integrate aspects of resource consumption, emissions into air, water and soil, waste generation and material use in the holistic analysis of urban systems. Developing skills in sampling, analysis and interpretation of water quality parameters in accordance with the standards and regulations in force. Developing the capacity to select materials used in urban infrastructure and to evaluate the influence of their properties on the performance, durability and sustainability of pipeline systems. Developing the skills to monitor and assess urban air quality, identify pollution sources and develop measures to improve the atmospheric environment. Developing an interdisciplinary approach to sustainability assessment, by correlating technical, economic and environmental aspects in the decision-making process. Developing the skills to identify, assess and monitor the main urban environmental problems and integrate the principles of sustainable development into infrastructure projects. Developing the skills to work in multidisciplinary teams and to communicate the results of environmental assessments. Developing an interdisciplinary and holistic approach to solving complex urban environmental problems.
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9. Contents

9.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
1. Presentation of the lecture content. Lecture objectives. Introductory notions. Standards in the field of life cycle analysis.	2	Exposure; Lecture; Explanation; Exemplification; Conversation; Problematization; Observation; Video projector (.ppt presentations).	
2. Environmental pollution and protection. The impact of anthropogenic activities on the environment. The material and energy balances.	2		
3. Environmental balance. Defining the notion of environmental balance. Types of environmental balances.	2		
4. The concept of sustainable development. The importance of product life cycle analysis to ensure the sustainable development of society.	2		
5. Life cycle analysis. Defining. Components of life cycle analysis. The importance of life cycle analysis to reduce the negative impact on the environment. The importance of life cycle analysis in the context of sustainable development.	4		
6. Product life cycle analysis. Methods of product life cycle analysis. Methods for assessing the environmental impact of the life cycle of products. Stages of product life cycle impact assessment - detailed approach.	4		
7. The end-of-life cycle stage. The pyramid of the end of the life cycle. Waste storage. Energy recovery. Recycling. Restoration / repair. Reuse. Valorization.	4		
8. Life cycle analysis as a method of waste minimization. Industrial waste management. Reuse, recycling and valorization of the wastes.	4		
9. Carbon footprint. Calculation of carbon emissions, specific to the product life cycle stages. Strategies to reduce greenhouse gas emissions.	2		
10. The BAT (Best Available Technology) concept.	2		
Bibliography			
1. Iluțiu – Varvara, D. A. – “Ecology and environmental protection”. U.T. PRESS Publishing, Cluj - Napoca, 2017, ISBN 973-606-737-247-2, 215 pages.			
2. Iluțiu – Varvara, D. A. - “The Generation and Transfer of Pollutant Substances in Industrial Processes”. U.T. PRESS Publishing, Cluj-Napoca, 2007, ISBN 978-973-662-344-8, 142 pages.			
3. Curran, M. A. - “Life Cycle Assessment Student Handbook”. Wiley, 2015.			
4. Curran, M. A. – “Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products”. Wiley-Scrivener, 2012.			
5. Guinée, J. B. – “Handbook on life cycle assessment operational guide to the ISO standards. The			

international journal of life cycle assessment". 7(5), 2002, 311-313.

6. Hester, E., Harrison, M. "Environmental impact of solid waste management". RSC, UK, 2002.
7. Horne, R., Grant, T., Verghese, K. - "Life cycle assessment: Principles, practice, and prospects". Csiro Publishing, 2009.
8. Klöpffer, W. - "Life cycle assessment". Environmental Science and Pollution Research, 4(4), 223-228, 1997.
9. Salvato, J., Nemerow, N. L., Agardy, F.J. - "Environmental Engineering". J. Wiley & Sons 2003.
10. Tchnobanoglous G., Theisen, H., Eliassen, R. - "Solid Wastes - Engineering principles and management issues". McGraw – Hill Book Company, 1977, USA .
11. Handbook of Clean Energy Systems, Jinyue Yan (Editor), Publisher: Wiley, 2015.
12. Life Cycle Assessment: Principles and Practice, EPA/600/R-06/060, 2006.
13. Life Cycle Engineering Guidelines, EPA Guidelines, 2001.
14. Environmental Engineers Handbook, CRC Press, 1999.
15. ***ISO 14040:2007 -A standard on principles and framework.
16. ***ISO 14041-A standard on goal and scope definition and inventory analysis.
17. *** ISO 14042-A standard on life-cycle impact assessment.
18. ***ISO 14043-A standard on life-cycle interpretation.

Journals:

1. International Journal of Lifecycle Assessment;
2. Journal of Industrial Ecology;
3. Environmental Science and Technology;
4. Environmental Science and Pollution Research;
5. Journal of Cleaner Production;
6. Sustainability;
7. Journal of Environmental Management;
8. Environmental Engineering and Management Journal;
9. Polish Journal of Environmental Studies;
10. Ecological Economics;
11. Energy etc.

9.2. Project	Number of hours	Teaching methods	Notes
1. Presentation of the case study requirements. Data on the case study.	2	Exposure; Exemplification; Case Study; Problematization; Brainstorming; Interactive discussions.	
2. Carrying out an individual case study on the life cycle analysis of a product. The case study must contain: all stages related to the life cycle of the studied product; inventory of inputs and outputs of a system; analysis on the impact of the life cycle of the studied product on environmental factors; the effects generated on human health; interpretation of the obtained results; proposals to reduce the negative impact on environmental factors; solutions for recycling, reuse and valorization of wastes; proposals on the BAT concept.	10		
3. Oral presentation of the case study.	2		
Bibliography			
1. Iluțiu – Varvara, D. A. – “Ecology and environmental protection”. U.T. PRESS Publishing, Cluj -			

Napoca, 2017, ISBN 973-606-737-247-2, 215 pages.

2. Iluțiu – Varvara, D. A. - "The Generation and Transfer of Pollutant Substances in Industrial Processes". U.T. PRESS Publishing, Cluj-Napoca, 2007, ISBN 978-973-662-344-8, 142 pages.
3. Navajas, A., Uriarte, L., Gandía, L.M., 2017, Application of Eco-Design and Life Cycle Assessment Standards for Environmental Impact Reduction of an Industrial Product, Sustainability, 9, 1724, doi:10.3390/su9101724.
4. ***ISO 14040:2007 -A standard on principles and framework.
5. ***ISO 14041-A standard on goal and scope definition and inventory analysis.
6. *** ISO 14042-A standard on life-cycle impact assessment.
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6. Sustainability;
7. Journal of Environmental Management;
8. Environmental Engineering and Management Journal;
9. Polish Journal of Environmental Studies;
10. Ecological Economics;
11. Energy etc.

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The content of the discipline is in accordance with the expectations of the representatives of the epistemic community, professional associations and employers in the field of "Civil and Building Services Engineering", through the complexity of the treated issue, referring to the life cycle analysis. The content of the course is compatible with that of similar disciplines taught at prestigious universities in the country and abroad.

11. Evaluation

Activity type	11.1 Assessment criteria	11.2 Assessment methods (and evaluation form: continuous/summative)	11.3 Weight in the final grade
11.4 Course	The colloquium consists in verifying the theoretical knowledge.	Oral valuation.	60 %
11.5 Project	Oral presentation of the case study.	Oral presentation of the case study.	40 %
11.6 Minimum standard of performance Individual development of a complex topic. Learning specialized terminology. The realization and oral presentation of the case study, conditions the participation to the colloquium. To promote the discipline are necessary: Project Note ≥ 5 ; Colloquium Note ≥ 5 .			

Date of filling in:		Title Surname Name	Signature
10.05.2026	Lecturer	Assoc. Prof. PhD. Eng. Dana-Adriana ILUȚIU-VARVARA	
	Teachers in charge of application	Assoc. Prof. PhD. Eng. Dana-Adriana ILUȚIU-VARVARA	

Date of approval in the Department of Building Services Engineering	Head of Department of Building Services Engineering,
09.07.2026	Assoc. Prof. PhD. Eng. Ciprian-Valentin BACOȚIU
Date of approval in the Council of the Faculty of Building Services Engineering	Dean,
09.07.2026	Assoc. Prof. PhD. Eng. Florin Vasile DOMNIȚA