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
1.8	Subject code	12.00

2. Data about the subject

2.1	Subject name			Life Cycle Analysis		
2.2	Course responsible/lecturer			Assoc. Prof. PhD. Eng. Dana - Adriana ILUŢIU - VARVARA Adresa de email: *dana.adriana.varvara@insta.utcluj.ro*		
2.3	Teachers in charge of projects			Assoc. Prof. PhD. Eng. Dana - Adriana ILUŢIU - 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					DS
	Optionality					DI

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) Manual, lecture material and notes, bibliography	30
(b) Supplementary study in the library, online and in the field	8
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	18
(d) Tutoring	-
(e) Exams and tests	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	Knowledge of environmental legislation on life cycle analysis. Knowledge of the provisions of the standards: ISO 14040 - Principles and framework; ISO 14041 - Definition of purpose, scope and inventory analysis; 14042 - Life cycle impact assessment; 14043 - Interpretation of the life cycle. Knowledge and interpretation of stages in life cycle analysis. Knowledge of methods analysis for product life cycle analysis. Knowledge of methods and tools for assessing the environmental impact of the life cycle of products. Knowledge and selection of impact categories (depletion of natural resources, greenhouse effect, ozone layer degradation, acidification, eutrophication, toxicological potential, land cover with wastes etc.) Analysis of the product from an environmental perspective using impact categories and category indicators related to the interpretation and quantification of input and output data for a system, product, in assessing the impact of the life cycle. Interpretation and application of information resulting from life cycle assessment in real situations. Identifying and specifying information related to the best available technologies in the field. Analysis of technological processes and projects in order to reduce the negative impact on the environment. Carrying out an individual study on the life cycle analysis of a product.
Cross competences	Ability to support, with scientific arguments, a point of view by assuming responsibilities for decisions made and related risks. Participation in one's own professional and scientific development. Improving one's own scientific and technical potential. Updating professional knowledge for continuous development.

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	Knowledge and deepening of the fundamental principles regarding the analysis of the life cycle of the products, in order to minimize the negative impact on the environment.
7.2	Specific objectives	Developing of skills regarding the elaboration of an individual study, regarding the analysis of the life cycle of a product. Applying the methods of environmental impact assessment of the set of activities associated with a product / process / technological flow, starting from the generation of raw materials and auxiliary materials until its final disappearance. Developing practical skills and creating the necessary skills for making decisions on the development of new products and technologies with minimal impact on the environment.

8. Contents

8.1. 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. Environmetal 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.

8.2. 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 nd 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.

9. 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.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The colloquium consists in verifying the theoretical knowledge.	Oral valuation.	60 %
10.5 Project	Oral presentation of the case study.	Oral presentation of the case study.	40 %

10.6 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 $\geq$ 5; Colloquium Note $\geq$ 5.

Date of filling in:		Title Surname Name	Signature
10.06.2025	Lecturer	Assoc. Prof. PhD. Eng. Dana - Adriana ILUŢIU - VARVARA	
	Teachers in charge of application	Assoc. Prof. PhD. Eng. Dana - Adriana ILUŢIU - VARVARA	

Date of approval in the Department of Building Services Engineering 19.06.2025	**Head of Department of Building Services Engineering,** Assoc. Prof. PhD. Eng. Ciprian-Valentin BACOŢIU
Date of approval in the Council of the Faculty of Building Services Engineering 19.06.2025	**Dean,** Assoc. Prof. PhD. Eng. Florin Vasile DOMNIŢA