

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				Renewable Energy Sources	Subject code	18.00	
2.2	Course responsible/lecturer				<i>Lect.phd.eng. Roxana MARE – Roxana.mare@insta.utcluj.ro</i>			
2.3	Teachers in charge of laboratory				<i>Lect.phd.eng. Georgiana CORSIUC – georgiana.corsiuc@insta.utcluj.ro</i>			
2.4	Year of study	II	2.5	Semester	I	2.6	Assessment	E
2.7		Subject category		Formative category				DF
				Optionaly				DOB

3. Estimated total time

3.1 Number of hours per week	2	of which	3.2 Course	1	3.3 Seminar		3.3 Laboratory	1	3.3 Project	
3.4 Total hours in the curriculum	28	of which	3.5 Course	14	3.6 Seminar		3.6 Laboratory	14	3.6 Project	
3.7 Individual study:										
(a) Exams and tests									2	
(b) Manual, lecture material and notes, bibliography									24	
(c) Supplementary study in the library, online and in the field									7	
(d) Preparation for seminars/laboratory works, homework, reports, portfolios, essays									14	
(e) Tutoring									-	
(f) Other activities									-	
3.8 Total hours of individual study (sum (3.7(a)...3.7(f)))					47					
3.9 Total hours per semester (3.4+3.8)					75					
3.10 Number of credit points					3					

4. Pre-requisites (where appropriate)

4.1	Curriculum	
4.2	Competence	Technical drawings, electrical, thermal, and mechanical engineering

5. Requirements (where appropriate)

5.1	For the course	Amphitheatre, B-dul 21 Decembrie Nr.128-130, Cluj-Napoca
5.2	For the applications Laboratory	Laboratory room, B-dul 21 Decembrie Nr.128-130, Cluj-Napoca

6. Specific competences

Professional competences	CP3 - promote innovative infrastructure design CP14 - integrate measures in architectural designs CP28 - promote sustainable energy CP29 - develop energy saving concepts
Cross competences	CT1 – works collaboratively in teams and networks. CT2 – thinks holistically. CT3 – solves problems.

7. Expected Learning Outcomes

Knowledge	CP3: Knows current trends in sustainable design, innovative solutions for the integration of renewable energy technologies, and the principles of developing infrastructure with a low environmental impact. CP14: Knows the principles of integrating renewable energy systems into building architecture, including functional, aesthetic, and technical requirements to ensure compatibility with architectural design. CP28: Knows the main types of renewable energy sources relevant to buildings and regenerative cities, including solar thermal, photovoltaic, wind, biomass, geothermal, and hydrogen technologies, as well as the principles for their integration into building services systems. CP29: Knows the principles of energy efficiency, energy management systems, energy performance indicators, and strategies for reducing energy consumption in buildings and urban developments.
Skills	CP3: Identifies opportunities to integrate new technologies into building services projects, proposes innovative solutions, and justifies their techno-economic advantages. CP14: Integrates renewable energy solutions into nZEB and regenerative building projects, aligning siting, orientation, efficiency, and operation requirements with architecture and building services. CP28: Analyses the local potential of renewable energy sources, selects appropriate technical solutions, carries out conceptual comparisons, and formulates recommendations for applications in buildings and urban contexts. CP29: Develops concepts for optimising energy consumption, integrates renewable sources and storage solutions, evaluates the energy performance of systems, and proposes improvement measures.

Responsibilities and autonomy	CP3: Initiates and supports innovative solutions in a responsible manner, assuming calculated risks and justifying the proposed options in relation to the course objectives and sustainability requirements.
	CP14: Collaborates autonomously with specialists from related fields and assumes responsibility for the technical and functional coherence of the proposed solutions.
	CP28: Acts autonomously in the technical substantiation of solutions based on renewable energy sources and assumes responsibility for the accuracy of the recommendations and for their contribution to decarbonisation and sustainability.
	CP29: Assumes responsibility for the substantiation of energy efficiency solutions and for their suitability to performance, sustainability, and operational requirements.

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

8.1	General objective	Developing competences in the field of renewable energy sources for nZeB buildings and regenerative cities.
8.2	Specific objectives	✓ Identify the renewable energy sources from the area of interest. ✓ The use of the latest technologies of the renewable energies in building services from regenerative cities after determining the energy demand of buildings and/or city. ✓ Design new building services, optimise and upgrade the existing building services and systems based on renewable energies. ✓ The integration of the building services and systems that use the renewable energies in the architecture of the nZeB buildings and regenerative cities. ✓ The use of theoretical knowledge in practice: dimensioning, analysis and choice of the optimum solution through specific software.

9. Contents

9.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
Overview. Renewable energy policy and statistics	1	Presentation and discussions	Video system
Solar energy – thermal plants	2		
Solar energy – photovoltaic systems	2		
Wind energy	2		
Hydropower	1		
Biomass and biofuels	2		
Geothermal energy	1		
Hydrogen and fuel cells	1		
Hybrid renewable systems for thermal and electrical energies	2		

Total	14		
Bibliography			
1. RES LEGAL Europe – Legal Sources on Renewable Energy - https://www.res-legal.eu/home/ 2. ***, Renewable Energy Policies in a Time of Transition, April 2018, IRENA 3. https://www.ecohz.com/facts/european-renewable-policy-framework/ 4. ***, Renewable Energy Statistics Report, IRENA – International Renewable Energy Agency, 2020 5. ***, Eurostat, Renewable Energy Statistics https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics 6. Boyle, G., Renewable Energy. Power for a Sustainable Future, Third Edition, Oxford University Press, 2012. 7. Shere J., Renewable., St. Martin’s Press, 2013 8. Sorensen B., Renewable energy. Its physics, engineering, use, environmental impacts, economy and planning aspects, Third Ed., Elsevier Science, 2004. 9. Yergin D., The New Map. Energy, Climate, and the Clash of Nations, The Penguin Press, 2020			
9.2. Laboratory	Number of hours	Teaching methods	Notes
Presentation of the project topic. Introduction to the basic concepts of off-grid systems. Distribution of the architectural floor plans.	2	Discussions, case study, team work.	
Site assessment and renewable resource analysis. Evaluation of the solar and wind potential of the location. Introduction of climatic data into the selected simulation software.	2		
Analysis of the household energy consumption. Determination of the house energy demand.	2		
Solar system sizing. Selection and placement of photovoltaic panels. Panel selection, roof analysis, optimal orientation and tilt angle.	2		
Wind system and energy storage sizing.			
System integration and final simulation. Comparison of two different solutions.	2		
Final paper presentation.	2		
Bibliography			
1. Mârza C., Hoțupan A., Moldovan R., Corsiuc G., Surse neconvenționale de energie (Renewable energy sources), Ed. U.T.PRESS Cluj-Napoca, 2013. 2. Boyle, G., Renewable Energy. Power for a Sustainable Future, Third Edition, Oxford University Press, 2012. 3. Fanchi, J. R.: Energy: technology and directions for the future. 2004, Elsevier. 4. ***Gex 13-2015 Ghidul privind utilizarea surselor regenerabile de energie la cladirile noi si existente, Ed. Matrix Rom. Bucuresti, 2016. 5. Kemp, W., Renewable Energy Handbook, Aztext Press, Canada, 2009. 6. Ali Keyhani, Design of smart power grid renewable energy systems , IEEE Press, 2011. 7. ***Hybrid Optimization by Genetic Algorithms (HOGA) software: https://ihoga.unizar.es/en/			

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

The competences achieved by the alumni are necessary in the field of design, production, consulting and marketing. Thus, the demands of the employees are satisfied.

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	Written exam	Test – 2 hours	50%
11.5 Laboratory	Verification of knowledge and abilities acquired as a result of class activities.	Oral examination	50%
11.6 Minimum standard of performance			
Students must pass the Laboratory test for the final exam. The components of the final grade are Exam (E) and Laboratory (L). Thus, the formula for the final grade of this subject is $N = 0.5x E + 0.5x L$. The 3 credits are obtained only if $N \geq 5$, where both $E \geq 5$ and $L \geq 5$.			

Date of filling in:		Title Surname Name	Signature
14.05.2026	Lecturer	Lect.phd.eng. Roxana MARE	
	Teachers in charge of application	Lect.phd.eng. Georgiana CORSIUC	

Date of approval in the Department of Building Services	Head of department
09.07.2026	Assoc.Prof.PhD.Eng. Ciprian BACOȚIU
Date of approval in the Faculty of Building Services Engineering	Dean
09.07.2026	Assoc.Prof.PhD.Eng. Florin DOMNIȚA