KYIV NATIONAL UNIVERSITY OF
CONSTRUCTION AND ARCHITECTURE
Doctor of Philosophy
Department of Labor Protection and Environment

«CONFIRM»
Dean of the Faculty of Engineering Systems and Ecology
_____/ O.V.Prymak /
«_03_» _ June __ 2020 year

SYLLABUS
of disciplines of normative special training
«SUSTAINABLE TECHNOLOGIES AND CERTIFICATION OF GREEN BUILDING IN THE CONDITIONS OF CLIMATE CHANGE»

(the name of academic discipline)

code	The name of specialty
101	Ecology
	the name of the educational program
	Ecology

Developer (s):
Tkachenko T.M., doc.t.s., professor _____
(surname and initials, scientific degree, rank) (signature)
Kryvomaz T.I., doc.t.s., professor _____
(surname and initials, scientific degree, rank) (signature)
_____
(surname and initials, scientific degree, rank) (signature)
_____
(surname and initials, scientific degree, rank) (signature)

Syllabus was approved at a meeting of the Department of Occupational Safety and Environment
Protocol № 7 of «03» of June 2020
Head of Department _____ (Voloshkina O.S.).
(signature) (surname and initials)

Approved by the scientific-methodical commission of the specialty
101 «Ecology»

Protocol № 2 of «03» June 2020
Head of SMK _____ Tkachenko T.M.
(signature) (surname and initials)

EXCERPT FROM THE CURRICULUM 2020-2021

code	master	Form of study: day, evening									Mark of approval
	Name of specialty (specialization)	Credits per semester	The number of hours ^					Independent work	Form of control	Semester	
			Total	classroom							
				In general	including						
					L	Lw	Pw				
101	Ecology	***4,0***	***120***				***80***	40	***E***	***3***	

Course structure

Module, name	lecturer	Number of hours per module	Number of hours	
			Practical training	Independent work
Module 1. Sustainable technologies of «green» construction in conditions of climate change	doc.t.s., prof. ***Tkachenko Tetyana Mykolayivna***	60	40	20
Module 2. Certification in «green» construction	doc.t.s., prof. ***Kryvomaz Tetyana Ivanivna***	60	40	20

1. General information about the course

Course title	**Balanced nature management**
Field of knowledge, code and name of specialty	10 «Natural Sciences» 101 «Ecology»
Semester	3
Normative/ selective	Normative (ОК 7)
Lecturer	**Tkachenko Tetyana Mykolayivna**, doc.tech. sciences, Professor of the Department of Labor Protection and Environment **Kryvomaz Tetyana Ivanivna**, doc.tech. sciences, Professor of the Department of Labor Protection and Environment
Teacher profiles	http://www.knuba.edu.ua/?page_id=34148 **Tkachenko Tetyana Mykolayivna** http://www.knuba.edu.ua/?page_id=53176
Teacher profiles	http://www.knuba.edu.ua/?page_id=38568 **Kryvomaz Tetyana Ivanivna** http://www.knuba.edu.ua/?page_id=38568
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E-mail Tkachenko T.M.:	tkachenkoknuba@gmail.com; tkachenko.tm@knuba.edu.ua
E-mail Kryvomaz T.I.	ecol@i.ua
Course page	KNUBA educational site http://org2.knuba.edu.ua https://teams.microsoft.com/l/team/19%3af26e3c77253d4103817cb7ccbd505336%40thread.tacv2/conversations?groupId=0d934d1c-16d6-46b2-9cc2-6f45288598fa&tenantId=53accf99-0147-476b-a787-42337aeb7273
Consultations Kryvomaz T.I.	*Face-to-face consultations* Kryvomaz T. I.: every Monday, 15:20-16.40, classroom 250 a. *Remote consultations* ecol@i.ua, Telegram; Zoom, TEAMS (Monday, Thursday, 17-19.00)
Consultations Tkacenko T.M.	*Face-to-face consultations* Tkachenko T.M.: every Tuesday, 15:20-16.40, classroom 250 a. *Remote consultations*: tkachenkoknuba@gmail.com; Viber, Telegram: 067 353 3877; Zoom

	https://teams.microsoft.com/l/team/19%3af26e3c77253d4103817cb7ccbd505336%40thread.tacv2/conversations?groupId=0d934d1c-16d6-46b2-9cc2-6f45288598fa&tenantId=53accf99-0147-476b-a787-42337aeb7273 (Tuesday, Friday, 12-14.00)

2. Course abstract

The course «Sustainable technologies and certification of green building in climate change» consists of two different modules taught by different lecturers:

Module 1. «Sustainable technologies of «green» construction in the conditions of climate change» (lecturer: doctor of technical sciences, Professor: ***Tkachenko Tetyana Mykolayivna*****)**

Module 2. «Certification systems and criteria for green building»

(lecturer: doctor of technical sciences Sciences, Professor: ***Kryvomaz Tetyana Ivanivna***)

Module 1. «Sustainable technologies of «green» construction in the context of climate change»

Today, the using of «green» technologies in «green» construction is considered, including the standpoint of providing climate services at the local and global levels. The module addresses a wide range of issues related to the using of «green» structures to improve the environmental safety of urbocenoses within the concept of "green" construction: classification problems, place and role of «green» structures in the system of sustainable urban development and «green» construction; the role of «green» structures in increased biocapacity and CO_2 sequestration; mathematical modeling of phytocenosis development; thermal characteristics of the plant layer on the «green» structures; methodology for determining the thermal resistance and «cooling effect» of the plant layer; assessment of indirect reduction of CO_2 emissions due to the «cooling effect»; types and designs of modern «green» roofs; construction and implementation in the domestic construction market and in EU countries; modern and original methods of calculation; regulatory framework.

3. The purpose and tasks of the course

The purpose of the discipline is to obtain new professional competencies and program learning outcomes on the provision of climate services through the introduction of sustainable structures of «green» construction that are necessary for

the implementation and design of their own research in the form of a dissertation.

Tasks of the discipline:

- to study the problem of classification of «green» structures;
- to determine the place and role of «green» structures in the system of sustainable urban development and «green» construction;
- to determine the role of «green» structures in increased biocapacity and CO_2 sequestration;
- to study and learn to apply the method of forecasting and evaluation of CO_2 sequestration by biomass of «green» structures;
- to study the concept of «cooling effect» of plants;
- to learn how to explore the phenological features of artificial phytocenoses of «green structures» and how to develop mathematical models of their development depending on the species set of plants, climatic and weather conditions of the region;
- to study the methodology for determining the thermal resistance and «cooling effect» of the plant layer, as well as the assessment of indirect reduction of CO_2 emissions due to the «cooling effect»;
- to study the main types of engineering systems of «green» structures.

4. Competences of searchers formed as a result of mastering the course

Integral Competence (IC)	Ability to solve complex problems in the field of ecology, environmental protection and sustainable use of nature in the implementation of research and innovation, which involves a deep rethinking of existing and creation of new holistic knowledge, mastering the methodology of scientific and scientific-pedagogical activities, conducting independent research have scientific novelty, theoretical and practical significance.
General competences	**GC01**. An ability to abstract thinking, analysis and synthesis. **GC02**. An ability to communicate in the state language both orally and in writing. **GC03**. An ability to communicate in a foreign language. **GC04**. An ability to conduct research at the appropriate level. **GC05**. An ability to search, processing and analyze information from various sources. **GC06**. An ability to identify, pose and solve problems. **GC07**. An ability to work in an international context. **GC08**. An ability to work autonomously.

	GC09. An ability to develop and manage projects.
Professional competences	**PC01**. An ability to assimilate concepts, theoretical and practical problems, history of development and current state of scientific knowledge in the field of ecology, environmental protection and optimization of nature. **PC03**. An ability to present the results of their own scientific and scientific and technical activities, including scientific publications. **PC04**. An ability to convey to students modern knowledge and scientific results of their own research, including in the framework of scientific and pedagogical activities in the field of natural sciences. **PC05**. An ability to intellectual creative activity aimed at obtaining new knowledge and (or) finding ways to apply them in the field of ecology, environmental protection and optimization of nature. ***Competences defined by the university*** **PC06.** An ability to predict and assess the impact of climate change on natural and artificial ecosystems and biota **PC07.** An ability to predict, plan and study the possibilities of reducing man-made impact on people and the environment by «green building» methods
Program learning results	**PR03** To plan and implement in practice an original independent scientific research, which is characterized by novelty, theoretical and practical value and contributes to the solution of significant ecological problems, environmental protection and sustainable use of nature. **PR04** Formulate, research and solve problems of ecology, environmental protection and sustainable using of nature by the scientific method of cognition. **PR05** Independently develop innovative comprehensive research projects in the field of ecology, environmental protection and optimization of nature management. **PR06** Apply methods of mathematical and geoinformation analysis and modeling of the current state and forecasting changes in ecosystems and their components. **PR07** Independently use modern equipment for research in the field of ecology, environmental protection and sustainable using of nature.

	PR08 Communicate, including in a foreign language, in a dialogue with the general scientific community and the public in the field of ecology, environmental protection and nature optimization. **PR09** Communicate clearly and unambiguously professional knowledge, the results of own research, justifications and conclusions both orally and in writing for different audiences, both nationally and internationally. **PR10** Apply modern technologies (including information) in scientific and scientific-pedagogical and ecological-educational activities. **PR11** Demonstrate leadership qualities, responsibility and full autonomy in the implementation of complex research projects. **PR12** Implement the intellectual property right to the results of scientific and scientific-technical activities within the framework of scientific ethics. ***Program learning outcomes determined by the university*** **PR13.** Develop recommendations, measures, standards and other regulations in the field of climate services and environmental improvement **PR14.** Independently use modern methods and technologies of «green building» to improve air quality and the condition of urbocenoses and agrocoenoses.

5. Course program according to the content module 1 «Sustainable technologies of «green» construction in the conditions of climate change»

The module consists of practical classes (40 hours) and independent work (20 hours). Practical classes take place in the form of online trainings under the UN Program for Reconstruction and Peacebuilding in conjunction with employers (according to the Memorandum of January 29, 2020). At the end of the training, graduate students receive certificates. Online training courses are also posted on the website of the Department of Occupational Safety and Environment KNUBA http://www.knuba.edu.ua/?page_id=87051, in the online group of graduate students Teams:
https://teams.microsoft.com/l/team/19%3af26e3c77253d4103817cb7ccbd505336%40thread.tacv2/conversations?groupId=0d934d1c-16d6-46b2-9cc2-6f45288598fa&tenantId=53accf99-0147-476b-a787-42337aeb7273

At the end of the practical classes 4 hours are devoted to the demonstration of scientific presentation, developed by every graduate student. After the

demonstration of each presentation there is a discussion and consideration with an overall result on a 100-point grading system.

The name of the topic of practical exercises	**Number of hours**
1. Problems of classification of «green» constructions	2
2. Urbanization as a process of increasing the ecological danger of cities	2
3. Videoecology	2
4. Natural and man-made danger of urbacenosis. Creating a sustainable anthropogenic landscape.	2
5. The assessment of the impact of construction objects on the environment	2
6. «Unhealthy building syndrome» as a direct threat to health	2
7. Natural «green technologies» as a way of improving the microclimate of the premises	2
8. "Green building". The concept of origin. Perspectives for the development of «green building» in Ukraine.	2
9. The role of «green» structures in reducing the ecological footprint of urbocenoses	2
10. The using of «green structures» for regulation rainwater runoff	2
11. Roof landscaping as a perspective energy-efficient ecological technology of urbocenoses	2
12. The history of roof landscaping	2
13. Synergistic combination of «green structures» and alternative energy sources	2
14. Rain gardens	2
15. Vertical landscaping	2
16. Landscaping of slopes	2
17. Ecoparkings	2
18. Facade «green» blocks	2
19. Preparing a presentation on your own research. Discussion. Results.	4
Total number	40

Independent work of graduate students takes place on the basis of the research center of ZinCo at the address: Lobanovsky Avenue, 72, 4th floor. Website https://www.rooftophub.com.ua/ (within the framework of the cooperation agreement between KNUBA and ZinCo, 2019). At a time convenient for both

participants in the educational process, graduate students independently visit ZINCO ROOFTOP HUB, where on the basis of logistics of employers study the issues covered by the program. If graduate students have additional questions, they receive the necessary expert advice provided by the SNP. At the end of the study of questions in the framework of independent work, ZinCo specialists conduct an interview with graduate students. Based on the results of the interview, grades are set according to a 100-point grading system.

Topics of questions for self-study	**Number of hours**
1. Research of phytocenoses of «green» roofs	2
2. System solutions for pitched «green» roofs	2
3. System solutions for intensive «green» roofs	2
4. System solutions for extensive «green» roofs	2
5. Systems for pitched «green» roofs	2
6. Safety on «green» roofs	2
7. Pedestrian paths and highways on roofs and underground garages	2
8. Software	2
9. Consultations of specialists	2
10. Interview with ZinCo specialists. Evaluation.	2
Total number of hours	20

The general assessment system according to Module 1 of the special course consists of three assessments: for practical classes (result - presentation, 40 points) and independent work (result - interview; 30 points). At the end of the module there is a final test (30 points).

6. Evaluation criteria

Evaluation criteria are presented on the KNUCA website, in the Regulations about the organization of the KNUCA educational process (item 5 Organization of control and quality of education): http://www.knuba.edu.ua/ukr/wp-content/uploads/2020/11/polozhennia-pro-orhanizatsiiu-navchalnoho-protsesu.pdf

Assessment scale: national and ECTS

The sum of points for all types of educational activities	ECTS assessment	Score due to the national scale	
		for exam, course project (work), practice	for an offset
90-100	**A**	perfectly	
82-89	**B**	good	

74-81	**C**		credited
64-73	**D**	satisfactorily	
60-63	**E**		
35-59	**FX**	unsatisfactory with the possibility of re-passing	not credited with the possibility of re-passing
0-34	**F**	unsatisfactorily with compulsory re-study of the discipline	not credited with compulsory re-study of the discipline

Methods of control and evaluation of postgraduate students' knowledge according to Module 1 «Sustainable technologies of «green construction» in the conditions of climate change»

Distribution of points for the discipline with the form of exam control

Current evaluation		Final test (exam)	Sum
Practical training	Independent work		
40	30	30	100

7.Logistics of the discipline

Laptop, multimedia equipment. Online classes are held by the use of Zoom . To study micro

For independent work: logistics ZINCO ROOFTOP HUB: a real "green" roof, demonstration materials, etc.

8. Course policy («rules of the game»)

KNUBA has developed and operates Regulations of events to support academic integrity: http://www.knuba.edu.ua/ukr/wp-content/uploads/2015/09/ .pdf

During the course, this «Regulation» is performed:

- The course includes practical classes and independent work.
- The atmosphere in online or offline audience is friendly, creative, open to constructive criticism.
- Mastering the discipline involves the mandatory implementation of the plan of practical and independent classes.
- Independent work includes the study of issues based on logistics of employers ZINCO ROOFTOP HUB. Independent work involves a final conversation with specialists, which affects the overall assessment of

the course.

- If the applicant is absent for a serious reason, he presents the completed tasks during self-training and teacher consultation.

- Academic integrity should not be violated during the work on tasks: when the applicant uses Internet resources and other sources of information, he must indicate the source used during the task. If the fact of plagiarism is detected, he receives 0 points for the task.

Methodical support

Basic:

1. Tkachenko T.M. Scientific and methodological bases of increasing the level of ecological safety of urbocenoses by creating energy efficient technologies of "green" construction. - Abstract of the dissertation for the acquisition of sciences. degree of doctor of technical sciences. - K .: TOV «Yuston», 2018. - 40 p.

2. Hasnutdinova A.I. Technology of vertical landscaping / A.I. Hasnutdinova, O.P.Alexandrova, A.N. Novik // Construction of unique buildings and structures - 12 (51), 2016. - P.20-32.

3. Tkachenko T. N. Energy efficiency of green technologies in modern urbocenoses / T. N. Tkachenko, I. Christ, Y. V. Polevaya // Scientific and technical collection "Energy efficiency in construction and architecture». – Issue 8. - K.: KNUBA, 2016. - P. 387-392.

4. Tkachenko T. N. Perspectives of "green" construction and alternative forms of landscaping in Ukraine / T.N. Tkachenko, V.A. Mileykovsky, V.G. Dzyubenko // Urban planning and spatial planning: Nauk.- tehn. Collection / Answer. ed. MM Osetrin. - Kyiv, KNUBA, 2016. - Issue. 60. - P. 324-334.

5. Tkachenko T. M. Green roofs as a resource of rainwater in the modern urbocenosis // Problems of water supply, drainage and hydraulics: Scientific and technical collection. Issue 27. - Kyiv: KNUBA, 2016. - P.364-369.

6. Tkachenko T. M. Research of heat transfer in energy-efficient green roofs / T.M. Tkachenko, V.O. Mileykovsky // Ventilation, lighting and heat and gas supply: scientific and technical collection. - Vip. 21. - Kyiv: KNUBA, 2017. - P. 37-48.

7. Tkachenko T. M. Green constructions in the concept of sustainable development of modern cities / T.M. Tkachenko, V.O. Mileykovsky // Sb. scientific tr. GVUZ «PGASA»: Construction, materials science, mechanical engineering. Series: Creation of high-tech eco-complexes in Ukraine on the basis of the concept of balanced (sustainable) development. - Dnipro: GVUZ «PGASA», 2017. - P. 179-186.

8. Tkachenko T. Mathematical model of extensive green roof with a steep type of phytocenosis // Ecological safety and nature management. - № 1 (25). –

Kyiv: KNUCA, 2018. – P.94-102.

9. Tkachenko T.M. Creation of energy efficient «green construction» in conditions of moderately continental climate // Ecological safety and nature management. - № 2 (26). – Kyiv: KNUCA, 2018. – P.77 -84.

10. Tkachenko T.M. Problems of classification and using of "green structures" in the greening of modern cities // Ecological sciences: scientific and practical journal. - № 1 (20). - Vol.2. - K .: DEA, 2018. - P. 21-24.

11. Tkachenko T.M. Green structures as an effective way to stabilize and improve the environment of urban coenoses (on the example of Solomyansky district of Kyiv) / T.M. Tkachenko, D.V. Guley // Ecological safety and balanced resource using: Ivano-Frankivsk , 2018. - P.46-56.

12. Tkachenko T.M. Full-scale studies of the «cooling effect» of vertical landscaping of buildings // Ventilation, lighting and heat and gas supply. - Vip. 25. - Kyiv: KNUBA, 2018. - P. 44-49.

13. Voloshkina O.S. Convective model of emission emission on the highway overpass under normal weather conditions / O.S. Voloshkina, V.V. Trofimovich, I.V. Klimova, R.V. Sipakov, T.M. Tkachenko // Ventilation, lighting and heat and gas supply. - Vip. 27. - Kyiv: KNUBA, 2018. - P. 23-31.

14. Tkachenko T. Investigation of the influence of grass cover on soil temperature for roof landscaping / T. Tkachenko, V. Mileykovsky // Budownictwo o zoptymalizowanym Potencjale energetycznym. Construction of optimized energy. - 1 (19). - Poland, 2017. - P. 67-72. (Copernicus Index)

15. Tkachenko T. Research of cooling effect of vegetation layer of green structures in construction / T. Tkachenko, V. Mileikovskyi // International Scientific and Practical conference «World science». – № 7 (23), Vol. 1, 2017. – P. 22-24. (Index Copernicus, Google Scholar)

16. Tkachenko TN Experience of creating green roofs in Ukraine // Proceedings of the International Scientific Conference «Topical problems of modern science» (June 16, 2017, Warsaw, Poland). - Vol. 4. - P. 23-27. (European database https://www.academia.edu)

17. Tkachenko T. Geometric Basis of the Use of «Green Constructions» for Sun Protection of Glazing / T. Tkachenko, V. Mileikovskyi // ICGG 2018 - Proceedings of the 18th International Conference on Geometry and Graphics. - Milan, Italy, August 3-7, 2018. – pp. 1096-1107. (Scopus)

18. Tkachenko T. Energy Efficiency of «Green Structures» in Cooling Period / T. Tkachenko // International Journal of Engineering & Technology. - 7 (3.2) (2018). – P. 453-457 (Scopus)

19. Tkachenko T. «Green structures» as a technical means of stabilization and improvement of the environmental state // Scientific letters of academic society

of Michal Baludansky. – № 6. – 2B., 2018. – P. 88-90.

20.Fabbri Kristian, Barbieri Fabrizio, Merli Francescaю Using natural fibre insulators on green roofs: some considerations. E3S Web of Conferences. 2020;197:02015 DOI 10.1051/e3sconf/202019702015

21. Rachel Gioannini, Malik Al-Ajlouni, Richard Kile, Dawn VanLeeuwen, Rolston St. Hilaire. Plant Communities Suitable for Green Roofs in Arid Regions. Sustainability. 2018;10(6):1755 DOI 10.3390/su10061755

22. Youcan Feng, Steven J. Burian, Eric R. Pardyjak. Observation and Estimation of Evapotranspiration from an Irrigated Green Roof in a Rain- Scarce Environment. Water. 2018;10(3):262 DOI 10.3390/w10030262

23. Carlos Vicente Rey, Natalia Franco, Gwendolyn Peyre, Juan Pablo Rodríguez. Green Roof Design with Engineered Extensive Substrates and Native Species to Evaluate Stormwater Runoff and Plant Establishment in a Neotropical Mountain Climate. Sustainability. 2020;12(6534):6534 DOI 10.3390/su12166534

24. Jiajun Zeng, Guoru Huang, Haiwan Luo, Yepeng Mai, Haichun Wu. First flush of non-point source pollution and hydrological effects of LID in a Guangzhou community. Scientific Reports. 2019;9(1):1-10 DOI 10.1038/s41598-019-50467-8

25. Haoming Chen, Jinyi Ma, Xinjun Wang , Pingping Xu, Shuo Zheng, Yanwen Zhao. Effects of Biochar and Sludge on Carbon Storage of Urban Green Roofs. Forests. 2018;9(7):413 DOI 10.3390/f9070413

26. Alexandra R. Rempel, Alan W. Rempel Intrinsic Evaporative Cooling by Hygroscopic Earth Materials. Geosciences. 2016;6(3):38 DOI 10.3390/geosciences6030038

27. Yaping Chen, Bohong Zheng,Yinze Hu. Numerical Simulation of Local Climate Zone Cooling Achieved through Modification of Trees, Albedo and Green Roofs—A Case Study of Changsha, China. Sustainability. 2020;12(2752):2752 DOI 10.3390/su12072752

28. Aman S. Gill, Kai Purnell, Matthew I. Palmer,Jaime Stein, Krista L. McGuire. Microbial Composition and Functional Diversity Differ Across Urban Green Infrastructure Types. Frontiers in Microbiology. 2020;11 DOI 10.3389/fmicb.2020.00912

29. Virginia A. Gallipoliti. Technologies according to design as didactic experiences in complementary facilities. Arquitecno. 2019;0(13):55-61 DOI 10.30972/arq.0134162

Additional:

1. Vertical gardens of Patrick Blanc. - [Electronic resource]. - Access mode: https://econet.ru/articles/64106-vertikalnye-sady-patrika-blanka. - Access date: 24.09.2017.

2. Alaeva NA The main directions of greening of buildings. - [Electronic

resource]. - Access mode: http://edu.secna.ru/publication/5/release/108/. - Access date: 25.09.2017

3. Vertigreen® - vertical landscaping system for indoor and outdoor use. - [Electronic resource]. - Access mode: http://zinco.com.ua/system/vertigreen/. - Access date: 25.09.2017.

4. Onishchenko L. Green roofs. Part II. History of appearance. - [Electronic resource]. - Access mode: http://o-p-i.ru/promyshlennoe-proektirovanie/14-staticheskie-stranitsy/proektirovanie/stati-i-publikatsii/961-zelenye-krovli-chast-ii-istoriya-poyavleniya.html. - Access date: 27.09.2017.

Information resources

1. http://library.knuba.edu.ua/
2. http://chitalnya.nung.edu.ua/node/5444
3. https://nenc.gov.ua/?page_id=128
4. Website of the Ministry of Environment: national reports on the state of the environment
environment, monitoring programs, etc. : http://www.menr.gov.ua/
5. Website of the Information and Analytical Center (IAC) of the Ministry of Environment: https://iacmenr.rgdata.com.ua/ShowPage.aspx?PageID=200
6. Site of the Ukrainian hydrometeorological center http://meteo.com.ua/
7. Website of the Ministry of Emergencies of Ukraine http://www.mns.gov.ua/opinfo/4689.html
8. Interactive web system for monitoring European river basins
European Environment Agency (maps of water monitoring networks,
etc.): http://www.eea.europa.eu/themens/water/mapviewers/myRBD
9. Google Maps - sets of satellite and vector maps with
attributive content, informational and photographic materials:
http://maps.google.com/
10. NASA Observation Data: http://earthobservatory.nasa.gov/
11. Data about the state of the environment in Europe - EAS: www.eea.europa.eu/
12. Databases on air condition of the European thematic center of EANS:
http://air-climate.eionet.europa.ua/databases/#ag
13. Catalog of remote sensing data of the State Enterprise «Nature» of the Ministry of Environment and NSAU for the whole
territory of Ukraine: http://www.pryroda.gov.ua:8080/katalog/search_film.do
14. Examples of remote sensing data: http://www.nkau.gov.ua/nsau/photo.nsf/photoU!
opoen & collapse = all
15. Remote sensing data from many satellites: http://search.kosmosnimki.ru/

16. Examples of the using of GIS technologies - the site of the company «Date +» (RF):
www.dataplus.ru, including the catalog of cartographic resources of the world: www.dataplus.ru/win/Catalog
17. Information about GIS products «ArcGIS» in Ukraine (official dealer's website ESRI (USA) – «ESOMMSo», Ukraine): www.ecomm.kiev.ua
18. Information on application examples and GIS products «Panorama» (Russian Federation): www.gisinfo.ru and their dealer in Ukraine: http://www.panorama.vn.ua
19. Information about GIS «Digitals» (site of SPE «Geosystem», Ukraine): www.vingeo.com
20. Information about GIS «VNetGIS» and interactive maps of regions and cities Of Ukraine www.uamap.net
21. Information on application examples, GIS products «Mapinfo» and interactive maps of the regions of Ukraine: the site of the official dealer in Ukraine: http://www.isgeo.com.ua

Module 2. «Green building certification systems and criteria»

An integrated approach of green building provides rational land use, saving natural resources and energy, water efficiency, reducing pollution and harmful emissions, high quality environment, safety and comfort, innovation and continuous improvement at all stages of construction projects. The module addresses issues related to the application of international systems of green building certification and ways of their practical implementation in the construction industry of Ukraine. The module is based on the principles of international standards for green building BREEAM (Building Research Establishment Environmental Assessment Methodology), LEED (Leadership in Energy and Environmental Design), DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen), HQE (Haute Qualité Environnementale system) and others. The module includes generalized criteria for green building: 1) project management; 2) health and safety; 3) land use and ecology; 4) transport and infrastructure; 5) energy efficiency; 6) sustainable resource use; 7) water efficiency; 8) air quality; 9) waste management. The methodology of life cycle assessment (LCA) of construction projects and materials is unified according to the International Organization for Standardization ISO 14040-14043.

3. The purpose and tasks of the course

The purpose of the course is to obtain new practical competencies in the

application of green building standards and criteria at all stages of planning and implementation of construction projects for using in the process of personal research and dissertation work.

Tasks of the course:

- to assess the impact of buildings on the environment across their entire life cycle, from masterplanning, design, new construction, in-use, reconstruction to refurbishment;
- to study international green building certification systems BREEAM, LEED, DGNB, HQE, etc.;
- to analyze the main criteria of green building: project management, health and safety, land use and ecology, transport and infrastructure, energy efficiency, sustainable resource use, water efficiency, air quality, waste management;
- to compare of Ukrainian environmental construction laws and regulations with international green building certification and find the way to implement green building in Ukraine;
- to learn of of life cycle assessment for construction projects and materials according to different methodologies of environmental impacts calculation at all stages;
- to develop of individual proposals for the introduction of green building standards in the construction industry of Ukraine.

4. Competences of searchers formed as a result of mastering the course

Integral Competence (IC)	Ability to solve complex problems in the field of ecology, environmental protection and sustainable use of nature in the implementation of research and innovation, which involves a deep rethinking of existing and creation of new holistic knowledge, mastering the methodology of scientific and scientific-pedagogical activities, conducting independent research have scientific novelty, theoretical and practical significance.
General competences	**GC01**. An ability to abstract thinking, analysis and synthesis. **GC02**. An ability to communicate in the state language both orally and in writing. **GC03**. An ability to communicate in a foreign language. **GC04**. An ability to conduct research at the appropriate level. **GC05**. An ability to search, processing and analyze

	information from various sources. **GC06**. An ability to identify, pose and solve problems. **GC07**. An ability to work in an international context. **GC08**. An ability to work autonomously. **GC09**. An ability to develop and manage projects.
Professional competences	**PC01**. An ability to assimilate concepts, theoretical and practical problems, history of development and current state of scientific knowledge in the field of ecology, environmental protection and optimization of nature. **PC03**. An ability to present the results of their own scientific and scientific and technical activities, including scientific publications. **PC04**. An ability to convey to students modern knowledge and scientific results of their own research, including in the framework of scientific and pedagogical activities in the field of natural sciences. **PC05**. An ability to intellectual creative activity aimed at obtaining new knowledge and (or) finding ways to apply them in the field of ecology, environmental protection and optimization of nature. ***Competences defined by the university*** **PC06.** An ability to predict and assess the impact of climate change on natural and artificial ecosystems and biota **PC07.** An ability to predict, plan and study the possibilities of reducing man-made impact on people and the environment by «green building» methods
Program learning results	**PR03** To plan and implement in practice an original independent scientific research, which is characterized by novelty, theoretical and practical value and contributes to the solution of significant ecological problems, environmental protection and sustainable use of nature. **PR04** Formulate, research and solve problems of ecology, environmental protection and sustainable using of nature by the scientific method of cognition. **PR05** Independently develop innovative comprehensive research projects in the field of ecology, environmental protection and optimization of nature management. **PR06** Apply methods of mathematical and geoinformation analysis and modeling of the current state and forecasting changes in ecosystems and their

	components. **PR07** Independently use modern equipment for research in the field of ecology, environmental protection and sustainable using of nature. **PR08** Communicate, including in a foreign language, in a dialogue with the general scientific community and the public in the field of ecology, environmental protection and nature optimization. **PR09** Communicate clearly and unambiguously professional knowledge, the results of own research, justifications and conclusions both orally and in writing for different audiences, both nationally and internationally. **PR10** Apply modern technologies (including information) in scientific and scientific-pedagogical and ecological-educational activities. **PR11** Demonstrate leadership qualities, responsibility and full autonomy in the implementation of complex research projects. **PR12** Implement the intellectual property right to the results of scientific and scientific-technical activities within the framework of scientific ethics. ***Program learning outcomes determined by the university*** **PR13.** Develop recommendations, measures, standards and other regulations in the field of climate services and environmental improvement **PR14.** Independently use modern methods and technologies of green building to improve air quality and the condition of urbocenoses and agrocoenoses.

5. Course program for module 2 «Green building certification systems and criteria»

The module consists of practical classes (40 hours) and home work (20 hours). Practical classes take the form of online workshops, after which graduate students receive certificates. Methodical support of the module is posted on the website of the Department of Occupational and Environmental Safety KNUBA. Upon completion of practical classes 4 hours are allocated for the presentation of their own research on the selected topic within the program of the module. The presentation demonstration ends with the communication in discussion groups.

The topic of practical classes	Number of hours
1. The impact of the construction industry to the environment and human health	2
2. Life cycle assessment in construction	2
3. International green building certification systems	2
4. Basic criteria and aspects of green building	2
5. Concept, masterplanning and management of the construction project	2
6. Land use and environmental impact assessment	2
7. Infrastructure of construction project	2
8. Quality, comfort, health and safety of the built environment	2
9. Energy efficiency and sustainable resource use	2
10. Minimization of environmental pollution	2
11. Waste management	2
12. Environmental assessment of building materials	2
13. Biophilic design	2
14. Economic green building justification	2
15. International green building laws and regulations	2
16. Ukrainian environmental laws and regulations for building	2
17. Examples of green buildings in Ukraine	2
18. Problems of green building implementation in Ukraine	2
19. Preparation of the individual research presentation. Discussion. Results.	4
Total	40

Independent work of graduate students takes place on the basis of enterprises and research institutions by prior arrangement on an individual basis. In case of additional questions, graduate students receive appropriate expert advice. As a result of independent work, graduate students perform an individual task that must be presented and defended in public. Additional points are awarded for conference presentations, scientific publications and participation in the project.

The topic of individual work	Number of hours
1. Certification green building schemes BREEAM	2
2. LEED green building standards	2
3. DGNB green building standards	2

4. International green building organizations working with an innovative technologies	2
5. Examples of life cycle assessment for building materials	2
6. Internet resources about green building	2
7. Examples of green building projects in different countries around the world	2
8. Proposals for the introduction of green building standards in Ukraine	2
9. Individual work defense	4
Total	20

The general assessment system according to Module 1 of the special course consists of three assessments: for practical classes (result - presentation, 40 points) and independent work (result - interview; 30 points). At the end of the module there is a final test (30 points).

6. Evaluation criteria

Evaluation criteria are presented on the KNUCA website, in the Regulations about the organization of the KNUCA educational process (item 5 Organization of control and quality of education): http://www.knuba.edu.ua/ukr/wp-content/uploads/2020/11/polozhennia-pro-orhanizatsiiu-navchalnoho-protsesu.pdf

Assessment scale: national and ECTS

<table>
<tr><td rowspan="2">The sum of points for all types of educational activities</td><td rowspan="2">ECTS assessment</td><td colspan="2">Score due to the national scale</td></tr>
<tr><td>for exam, course project (work), practice</td><td>for an offset</td></tr>
<tr><td>90-100</td><td>A</td><td>perfectly</td><td rowspan="5">credited</td></tr>
<tr><td>82-89</td><td>B</td><td rowspan="2">good</td></tr>
<tr><td>74-81</td><td>C</td></tr>
<tr><td>64-73</td><td>D</td><td rowspan="2">satisfactorily</td></tr>
<tr><td>60-63</td><td>E</td></tr>
<tr><td>35-59</td><td>FX</td><td>unsatisfactory with the possibility of re-passing</td><td>not credited with the possibility of re-passing</td></tr>
<tr><td>0-34</td><td>F</td><td>unsatisfactorily with compulsory re-study of the discipline</td><td>not credited with compulsory re-study of the discipline</td></tr>
</table>

Methods of control and evaluation of postgraduate students knowledge according to Module 2 «Green building certification systems and criteria»

Distribution of points for the discipline with the form of exam control

Current evaluation		Final test (exam)	Sum
Practical training	Independent work		
40	30	30	100

7. Logistics of the discipline

Laptop, multimedia equipment. Laboratory equipment for the building microclimate, quality criteria and comfort of buildings studies is available in lab.74 of the central building of KNUCA. The Zoom and TEAMS platforms use for online lessons. The exchange of information and communication is carried out in the Telegram.

8. Course policy

KNUBA has developed and operates Regulations of events to support academic integrity: http://www.knuba.edu.ua/ukr/wp-content/uploads/2015/09/ .pdf

During the course, this «Regulation» is performed:

- The course includes practical classes and independent work.
- The atmosphere in online or offline audience is friendly, creative, open to constructive criticism.
- Mastering the discipline involves the mandatory implementation of the plan of practical and independent classes.
- Independent work includes investigation and information research, exchange of information with other students of the course, involves the final individual task and its public defense, presentation on conferences and preparation of scientific publications.
- If the applicant is absent for a serious reason, he presents the completed tasks during self-training and teacher consultation.
- Academic integrity should not be violated during the work on tasks: when the applicant uses Internet resources and other sources of information, he must indicate the source used during the task. If the fact of plagiarism is detected, he receives 0 points for the task.

Methodical support

Basic:

1. Kryvomaz T., Varavin D. Improving the level of environmental safety in the process of the ecoenergoefficient reconstruction of the housing stock in Kiev // USEFUL online journal. – 2017. - 1(2) - P.19-29.
2. Kryvomaz T.I., Michaud A., Varavin D.V., Perebynos A.R. French green building rating systems // Environmental safety and nature use. – 2018. – Vol. 27, № 3. – P. 40-48.
3. Kryvomaz T.I., Scudu I., Leonard D., Minter D. Green building BREEAM in Ukraine / Environmental safety and nature use. – 2019. - Vol. 1 (29). - C. 5-15.
4. Kryvomaz T., Varavin D. Applying of green building standards for implementation of the city development strategies in Kyiv // USEFUL online journal. 2019. - vol. 3, no. 1 - P.16-30.
5. Proceedings of the First International Scientific and Practical Conference "Green Building". - Kyiv: KNUCA, November 12-13, 2019.
6. Kryvomaz T.I., Karpenko N.S. Green standards to improve office operations in the new environment // Environmental safety and nature use. – 2020. - 34(2) - P.5-21.
7. Kryvomaz T., Varavin D. The ways to increase the environmental safety of the urban environment in connection with the pandemic COVID-19 // Environmental safety and nature use. – 2020. - 36 - P.41-55.
8. Kryvomaz T., Chmielewska J., Kanashchuk T. The prospects of green building developing in ukraine on example of Poland // Environmental safety and nature use. – 2020. - 36 - P.20-31.
9. Kryvomaz T. Estimation of influence of ventilation systems on microbiological safety and microclimatic conditions of premises / T.I. Кривомаз, Д.В. Varavin, RV Sipakov, RS Kuzmishina // Ventilation, lighting and heat and gas supply. – 2020. – Vol. 34. – P. 24- 32.

Additional:

10. BREEAM Communities for developments at the neighbourhood scale or larger
11. BREEAM International New Construction for new-build domestic and non-domestic buildings
12. BREEAM In-Use for existing non-domestic buildings in-use
13. BREEAM International Refurbishment for non-domestic building fit-outs and refurbishments.

Information resources

14. Agence de la transition écologique (ADEME). – https://www.ademe.fr.
15. BRE Academy. - https://www.bre.ac.
16. BRE Global. - https://www.bregroup.com/about-us/bre-global/

17. BRE Trust. - https://bregroup.com/bretrust/
18. Building Research Establishment (BRE) – https://www.bregroup.com/
19. Building Research Establishment Environmental Assessment Method (BREEAM) –https://www.breeam.com.
20. CEEQUAL - http://www.ceequal.com/
21. Eco-Management and Audit Scheme (EMAS). – www.ec.europa.eu/environment/emas/index_en.htm.
22. Écoresponsable au bureau. Actions efficaces et bonnes résolutions. https://www.ademe.fr/sites/default/files/assets/documents/guide-pratique-ecoresponsable-au-bureau.pdf
23. Green book live www.greenbooklive.com
24. La Semaine Européenne de la Réduction des Déchets (SERD) https://www.serd.ademe.fr.
25. Le label des PME qui s'engagent pour l'environnement (EnVol) www.envol-entreprise.fr.
26. On the following you can find a list a list of BREEAM documents that should help you understand BREEAM value and benefits:https://www.breeam.com/discover/resources/.
27. Plan de Déplacements Entreprise www.ademe.fr/sites/default/files/assets/documents/ademe_affiches_pde.pdf.
28. The Leadership in Energy & Environmental Design (LEED) https://www.usgbc.org/leed.
29. Wiki Green building https://www.designingbuildings.co.uk/wiki/Green_building
30. World Green Building Council (WGBC) http://www.worldgbc.org/what-green-building.