MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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Methodical recommendations

for practical classes and organization of independent work

in the discipline

"ARCHITECTURAL ECOLOGY"

(for third-year students of full-time study of specialty
191 – Architecture and Urban Planning)

Kharkiv
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INTRODUCTION

The purpose of studying the discipline “Architectural ecology” is to form a theoretical and practical foundation of general training of student-architect, based on knowledge of modern environmental trends in architecture, methods of energy efficient buildings, basic design and planning tools for environmental design of architectural objects, the impact of architectural urban planning industry on the state of the environment, the main environmental problems of the architectural surrounding and means of overcoming them.

Tasks of studying the discipline:

– identifying the role of the architect in the formation of sustainable architectural environment;

– analysis of the main features of ecological constructions modern directions;

– identification of modern methods and directions of energy efficient buildings formation;

– identification of optimal methods of regulating the parameters of the architectural objects internal environment, taking into account specific climatic and urban conditions;

– identification of the main negative factors that affect the state of the architectural object or the environment, and compositional-planning and constructive means of overcoming them.

Interdisciplinary links. The study of this discipline is directly based on such disciplines as “Building Physics”, “Landscape Architecture”, “Typology of buildings and structures”. The study of this discipline is a preliminary for the disciplines “Architectural design of buildings and structures”, “Methods and techniques of architectural design”, “Architectural design in urban and natural landscapes”.

1 CONTENT OF THE COURSE BY CONTENT MODULES

Module 1 Architectural ecology

Content module 1 Fundamentals of architectural ecology.

The historical and regional features of the interaction of architectural and urban planning activities and the natural environment, as well as the prerequisites for the emergence of ecological culture in architecture are considered and analyzed. In this context, special attention is paid to the concept of sustainable urban development. The specifics of regulatory and legal support for the regulation of environmental parameters of the architectural and urban planning industry in Ukraine and in the world are noted. The main issues of architectural ecology and its role and place in the training of a modern architect, as well as current trends in the ecological formation of the architectural environment are analyzed.

Content module 2 Fundamentals of energy efficient architecture formation.

Peculiarities of designing eco-buildings, energy-efficient and energy-active buildings, passive and active energy supply systems of buildings are considered and analyzed. The specifics and ecological advantages of underground urban planning are revealed. The protective properties of the relief in the context of energy saving are analyzed. The main constructive and planning means of ecological formation of architectural objects are determined. Factors of comfort of the architectural environment are determined. Rational constructive and planning decisions for improvement of ecological parameters of the building are revealed.

Content module 3 Specifics of ecological formation of architectural and town-planning objects.

The subject of consideration and study in this thematic block are the main principles of formation of eco-cities, namely the concept of eco-city and architectural and town-planning means and methods of eco-cities formation. Factors of pollution and disturbance of the urban environment in the system of mutual influence “architecture – environment” are analyzed. Architectural and planning means of

reducing the negative impact of a set of factors on architectural or urban planning objects are considered.

2 STRUCTURE OF THE COURSE

In the study the discipline “Architectural ecology” the student must get acquainted with the program of the discipline, with its structure, content, and scope of each content module, with all types and methods of knowledge control (тabl. 2.1).

Table 2.1 – The structure of the credit of the discipline

Content modules	Number of hours				
	total *	lectures	practical	lab.	independent work
MODULE 1 Architectural ecology	90	17	17	–	56
Content module 1	15	5	5	–	5
Content module 2	30	6	6	–	18
Content module 3	30	6	6	–	18
Final control	15	–	–	–	15

3 STRUCTURE AND CONTENT OF LECTURES

Lecture is the main form of educational process in high school and, at the same time, a form of conducting educational classes designed to master theoretical material. It is carried out, mostly, in the form of an oral presentation of the information content of the subject by the teacher. The purpose of the lecture is to reveal the main provisions of the topic, to find out unresolved problems, to summarize the experience, to provide recommendations for the use of the main conclusions on the topics in practical classes.

The structure and content of lectures should correspond to the working program of the discipline (tabl. 3.1).

Table 3.1 – Lecture plan

Topic	Contents (plan)	Number of classroom hours
1	2	3
Module 1 Architectural ecology		**17**
Content module 1 Fundamentals of architectural ecology		**5**
1.1 Historical preconditions of ecological bases in architectural activity formation	– History of the interaction of architecture and the natural environment. – The concept of sustainable development of the urban environment. – Regulatory and legal support for the regulation of environmental parameters of the architectural and urban planning industry in Ukraine and in the world. – The main issues of architectural ecology and its role and place in the training of modern architects.	2
1.2 Modern tendencies of architectural environment ecological formation	– Eco-architecture. – Architectural bionics. – Organic architecture. – Bioclimatic architecture. – Landform architecture. – Plants as a means of “ecologization” architectural objects.	3
Content module 2 Fundamentals of energy efficient architecture formation		**6**
2.1 Principles of designing ecological energy-efficient buildings	– Eco-buildings like energy-efficient and energy-active buildings. – Passive and active energy supply systems of buildings. – Environmental benefits of underground urban	4

Continuation of table 3.1

1	2	3
	planning. – Energy saving and protective properties of a relief.	
2.2 Structural and planning means of architectural objects ecological formation	– Factors of the architectural environment comfort. – Rational design and planning solutions to improve the environmental parameters of the building.	2
Content module 3 Specifics of ecological formation of architectural and town-planning objects		**6**
3.1 The main principles of formation of eco-cities	– The concept of eco-city. – Architectural and urban planning tools and methods of forming eco-cities.	1
3.2 Factors of urban pollution in the system of mutual influence "architecture – environment"	– Noise as a factor influencing architectural objects and the environment. – Vibration pollution of the human environment – Air pollution and water pollution. – Electromagnetic pollution as a factor influencing the environment.	3
3.3 Factors of urban environment violation	– Flooding as the main ecological factor of disturbance of urban areas. – Violation of the aeration regime of urban areas. – Architectural and planning means to reduce the negative impact of a set of factors. – Geodynamic zones as a special factor in the system “architecture – environment”.	2

4 STRUCTURE AND CONTENT OF PRACTICAL CLASSES

Practical class is a form of training aimed at developing skills and abilities to perform certain types of work. It is a form of study in which the teacher organizes a detailed consideration by students of certain theoretical provisions of the discipline and forms the skills and abilities of their practical application through individual performance in accordance with the formulated tasks. Practical classes largely provide the development of skills and abilities to make practical decisions in real production conditions, based on a theoretical basis, develop logical thinking, the ability to analyze phenomena, summarize facts, promote regular and systematic independent work in the study of the discipline.

On each topic the teacher conducts practical classes, which develops students' skills and abilities of practical application of certain theoretical provisions of the discipline by individual performance of graphical and analytical tasks.

The structure and content of practical classes should correspond to the working program of the discipline (tabl. 4.1).

Table 4.1 – Plan of practical classes

Тема	Зміст (план)	Кількість ауд. год.
1	2	3
Module 1 Architectural ecology		**90**
Content module 1 Fundamentals of architectural ecology		**5**
1.1 Analysis of the application of eco-technologies in architecture (on the example of architecture of different regions of the world)	– analysis of the specifics of natural and climatic conditions and environmental problems of different regions of the world; – identification of regional features of architecture (eco-technologies), due to natural and climatic conditions (graphic-analytical task)	2

Continuation of table 4.1

1	2	3
1.2 Architectural and planning organization of the building in the architectural bionics style (sketch-idea)	– analysis of the architectural and planning organization of existing buildings in the architectural bionics style; – designing a sketch-idea of a public building in the architectural bionics style (graphic-analytical task)	3
Content module 2 Fundamentals of energy efficient architecture formation		**6**
2.1 Analysis of structural, architectural, and planning, compositional, and functional features of an energy efficient building	– analysis of energy efficient buildings by architectural-planning, three-dimensional and spatial, structural and engineering-technical parameters; – identification of positive and, if available, negative aspects of energy efficient buildings from domestic and foreign experience; – student author's analysis of an energy efficient building (graphic-analytical task)	2
2.2 Architectural and planning organization of an energy-efficient individual house (sketch-idea)	– pre-project analysis (analysis of existing architectural and urban conditions); – identification of a range of energy efficient technologies that can be applied in specific conditions; – inclusion of selected energy efficient technologies in the architectural and planning solution of a individual house: plan s, facades and sections of the building (if necessary) and its visualization (graphic-analytical task); – description of planning, construction and	4

Continuation of table 4.1

1	2	3
	engineering characteristics of the building	
Content module 3 Specifics of ecological formation of architectural and town-planning objects		**6**
3.1 Comparative analysis of urban conditions and architectural and planning decisions of buildings on the level of noise pollution	– distance from highways with intensive traffic; – distance from city rail transport (tram tracks); – placement of one-room apartments and two-room apartments of unilateral orientation in relation to the main noise sources; – the number of rooms of three-room and four-room apartments located in the zone of noise discomfort	2
3.2 Architectural and planning organization of a noise-protected multi-storey residential building (sketch-idea)	– pre-project analysis (analysis of existing urban conditions, taking into account the location of existing highways and orientation around the world); – placement on the set territory of the noise protection building; – designing (selection) apartment planning and their placement in a noise-proof building of sectional or gallery type (graphic-analytical task)	4

Practical lesson on the topic 1.1.

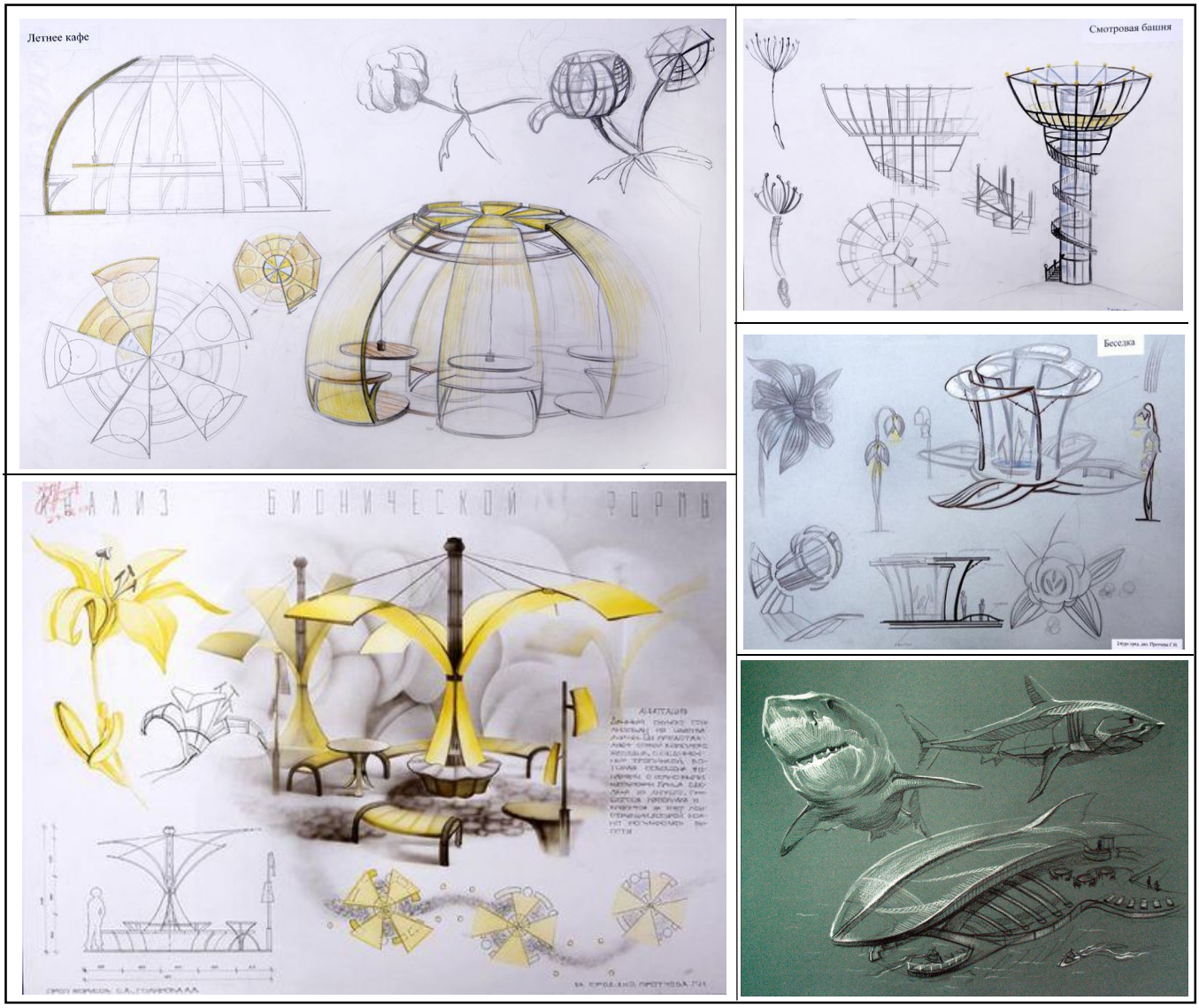
The first examples of eco-technologies in architecture, which allowed to improve the level of comfort and safety of housing are considered on the practical lesson. Teacher and students discuss and analyze “problem” regions (seismically dangerous, flooded, with very high or very low temperatures, significant differences in daily temperatures, etc.), and the architectural solutions used in these regions.

The student's task is to identify the “problem” region, to identify its inherent climatic or environmental problems, as well as to identify the architectural means by

which people solve these problems. Graphic design of analytical material is performed on the A3 format. The graphic work includes: text block (to define the region, problems, and architectural eco-technologies); illustrative block (images of the researched architectural objects).

Practical lesson on the topic 1.2.

On the practical lesson teacher and students research and analyze existing buildings and structures erected in the architectural bionics style, determine which aspects of a living organism (constructive or figurative) were a priority in developing a design solution. Graphic design of the sketch-idea of the building in the architectural bionics style is performed on the A3 format. The graphic work includes images of a natural prototype, sketches of plans, facades, and general view of the building.



Picture 1 – Examples of Practical exercise on the topic 1.2

Practical lesson on the topic 2.1.

The methodology of analysis of energy efficient buildings by architectural-planning, spatial, structural, and engineering parameters are considering and researching on the practical lesson. Teacher and students discuss and analyze design solutions for energy efficient buildings from domestic and foreign experience, identify their positive and, if available, negative sides.

Graphic design of analytical material on the organization of energy efficient buildings is performed on the A3 format.

The graphic work includes drawings of plans, facades and sections of the building or their visualizations; description of planning, structural and engineering characteristics of the building; student author's analysis of this energy efficient house.

Practical lesson on the topic 2.2.

The main types, methods and means of organizing energy efficient buildings are researching on the practical lesson. A sketch-idea of an energy efficient individual house is designing.

Graphic design of the sketch-idea of an energy efficient individual house is performed on the A2 format.

Students choose the appropriate plans and facades of the house, show the sections and the general perspective or axonometry. The orientation around the world is shown. The energy efficient building type (passive or energy-active) of the designed architectural object is determined. A detailed description of architectural and planning, structural and engineering tools used to achieve energy efficiency of the building (compactness of the plan, insulation, direct solar heating, thrombus wall, recess, solar panels, wind turbines, etc.) is a mandatory part of the work.

Practical lesson on the topic 3.1.

A comparative analysis of the level of noise comfort of multi-storey residential buildings with the same architectural and planning solution (but located in different urban conditions according to the level of noise pollution) is helding on the practical lesson. The following characteristics are analyzed: distance from highways with intensive traffic; distance from city rail transport (tram tracks); placement of one-room

apartments and two-room apartments of unilateral orientation in relation to the main noise sources; the number of rooms of three-room and four-room apartments located in the zone of noise discomfort.

The work is performed on the A3 format using real cartographic materials. The outline or color on the map identifies the buildings being analyzed and provides brief textual comments.

5 INDEPENDENT EDUCATIONAL WORK OF STUDENTS

The student's independent work is a form of organization of the educational process in which the planned tasks are performed by the student under the methodical guidance of the teacher, but without his direct participation.

It is an integral part of the educational process, which contributes to the deepening and expansion of knowledge, increasing interest in cognitive activity, the formation of a creative personality of a specialist capable of self-improvement and self-education. Independent work corresponds to the curriculum.

Structure of independent work includes the following components:

– research of Ukrainian and foreign normative-legal documentation on regulation of ecological parameters of architectural-town-planning branch;

– review of literary and electronic sources of information on the main directions of ecological construction;

– review of literary and electronic sources of information on structural and planning means of greening of architectural objects;

– research of Construction norms and rules and other normative documentation regulating ecological and hygienic parameters of the internal environment of architectural objects;

– research of Construction norms and rules and other normative documentation on noise regulation, etc.;

– research of Construction norms and rules and other normative documentation on flooding and aeration regime of urban areas.

Questions for self-control of knowledge:

1. Define the terms “architecture”, “ecology” and “architectural ecology”.
2. What issues in the field of ecology should be understood by a modern architect? What is his role in forming an environmentally sustainable architectural environment?
3. Name the main issues of architectural ecology.
4. What the ancient architectural and urban planning tools to improve the ecological (sanitary and hygienic) parameters of the environment do you know?
5. How has the attitude of people to the environment changed during the development of civilization?
6. What ideology became the leading in the architecture of the end of the XX – the beginning of the XXI centuries?
7. On what modern Ukrainian regulations in the field of construction and environmental protection are based? What are the current rules in this area?
8. What is the gist of environmental and energy efficiency standards of BREEAM and LEED buildings?
9. What is eco-architecture?
10. What do you know about modern trends in eco-architecture?
11. On what principles of interaction of nature and architectural form is based architectural bionics?
12. What are the features of organic and bioclimatic architecture?
13. What types of eco-buildings do you know?
14. What are the advantages of an eco-building?
15. What examples of modern energy efficient buildings do you know?
16. What are the European requirements for energy saving of buildings?
17. What is an energy efficient and an energy-economic building?
18. What is the fundamental difference between energy-economic and energy-efficient buildings?
19. What are biopositive buildings? What tools should be used in the reconstruction of existing buildings and construction of new biopositive structures?

20. What effective energy-saving architectural and planning solutions do you know?

21. What do you know about the ecological advantages of underground structures?

22. Name the main types of construction of underground structures.

23. What engineering problems should be considered in underground construction?

24. What types of deep-seated buildings do you know by depth?

25. What are the types of deep-seated buildings by the nature of the volumetric-spatial solution?

26. What are the features of the compositional-planning and volumetric-spatial organization of each type of deep-seated buildings?

27. What are the special design requirements for the construction of deep-seated buildings?

28. What groups of factors determine the comfort of a person in the building?

29. What components of the capital factor do you know?

30. In what aspects should the functional comfort factor be considered?

31. What factors are considered in the ecological and hygienic assessment of the indoor environment of the premises?

32. What should be the normative parameters of the heat-humidity regime?

33. What is insolation? What are the rules for insolation and orientation of apartments?

34. What is the dependence of the planning structure of houses and apartments on the orientation of the horizon and the meridional or latitudinal location of buildings?

35. What planning techniques to improve the insolation regime in unfavorable areas and in buildings do you know?

36. How building materials influence on the level of chemical pollution, toxicity, and radioactivity of buildings?

37. What should be the schemes of ventilation and orientation of buildings?

38. What types of sun protection equipment, spatial planning and design techniques for sun protection do you know?

39. What is noise? What are its main characteristics?

40. What means of air noise protection do you know?

41. How can shock noise be prevented?

42. List the measures to reduce noise levels in housing.

43. What is noise-proof house? What are its features?

44. What is the negative impact of vibration on architectural structures and human health? What do you know about the protection of buildings from vibration?

45. What is the effective way to improve the parameters of atmospheric air?

46. How can water pollution influence on building structures?

47. What effect does electromagnetic pollution have on human health?

48. What is flooding? What factors determine its occurrence?

49. How does flooding influence on architectural objects?

50. What planning and technical means of flood protection do you know?

51. What aerodynamic disturbances do you know?

52. What are the requirements for wind protection of urban areas?

53. What are the architect tasks to regulate the wind regime of urban areas?

54. What are the complexities and contradictions of the protective landscaping organization in influence of several factors?

55. How to choose a planning solution for protective landscaping strips?

56. What are geodynamic and hepatogenic zones?

57. How do geodynamic zones influence on architectural and urban planning objects? How do hepatogenic zones influence on human health?

58. What is sustainable development of the city?

59. What are the basic principles of sustainable development of the city?

60. What is the essence of the landscape-ecological approach to the urban environment organization?

61. What international measures aimed at the development of ecological construction do you know?

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