



SUSTAINABLE INNOVATIVE DEVELOPMENT

Working program of educational discipline (Syllabus)

Requisites of educational discipline

Higher education level	<i>Другий (магістерський)</i>
Knowledge domain	<i>12 Information technologies</i>
Speciality	<i>121 Software Engineering</i>
Educational program	<i>Software Engineering of Multimedia and Information Retrieval Systems</i>
Status of the discipline	<i>Normative</i>
Form of education	<i>Full-time (day-time)</i>
Year of preparation, semester	<i>I course, spring semester</i>
Teaching hours	<i>60 hours / 2 credits ECTS (lections – 18 hours, seminars – 18 hours, self students studying – 24 hours)</i>
Semester control / control activities	<i>Semester test, modular test</i>
Schedule	<i>https://schedule.kpi.ua/ 1 h. of lections and 1 h.practical (seminar) classes per week</i>
Language of study	<i>English</i>
Information about supervisor of the course / professors	<i>Lectons and seminars are given by: cand. of tech. sciences, assoc. prof., , assoc. prof. of Department of MMSA Dzhygyrey Iryna Mykolaivna, lab.mes@kpi.ua</i>
Course link	<i>https://do.ipk.kpi.ua/course/view.php?id=2620</i>

Program of educational discipline

1. Description of the discipline, its purpose, subject of study and learning outcomes

Sustainable development is a dynamically developing concept with different aspects and interpretations reflecting a vision of the world appropriate to local and cultural conditions in which the development process "serves to meet the needs of the present generation without compromising the ability of future generations to meet their own needs." Implementation of ideas of sustainable development is impossible without popularization of this idea in society. To provide education for sustainable development, it is necessary to have a clear idea of what sustainable development means and what goals it pursues. According to the recommendations of the UN Conference on Sustainable Development (Rio de Janeiro, 2012), the study of sustainable development issues should be an integral part of training programs. Within the scope of studying this discipline, students acquire a complex of knowledge in the following directions of sustainable development: innovations for society development, innovations in the use of environmental resources, and innovative economic and technological development as a driving force of sustainable growth.

*The **purpose** of the discipline is to form an appropriate level of knowledge and experience in operating the basic principles and approaches in the sustainable innovations sphere for provision and support of the coevolution development of humans and the Biosphere.*

*The **subject** of the discipline is modern innovations directed at solving social, economic, and environmental problems, improvement of conditions and quality of people's life, environmental damage reduction, and preservation of living conditions for future generations.*

The discipline contributes to the formation of students with the following **competencies**:

- GC01 ability to abstract thinking, analysis and synthesis.
- GC04 ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity).
- GC05 ability to generate new ideas (creativity).
- PC07 ability to critically comprehend problems in the field of information technology and at the frontiers of knowledge, to integrate relevant knowledge and solve complex problems in broad or multidisciplinary contexts.

After mastering the discipline, students must demonstrate the following **learning outcomes**:

PLO14 predict the development of software systems and information technology.

In particular, know:

- the latest concepts and principles and relevant documents of the world community on sustainable development;
- basic information about the world's modern trends in the development of global society and socio-economic threats and risks,
- basic information about the international experience of taking into account the goals of sustainable development in the creation of innovative projects and the role of eco-innovations in their achievement;
- a synergistic approach to the study of sustainable development problems;
- methods and models for assessing and forecasting sustainability and development of various scale objects;
- problems of energy saving and resource-technological aspects of low-carbon growth;
- basic concepts and principles of the digital economy and smart urban development.

In particular, obtain skills:

- implement innovative and socially, environmentally, and economically effective solutions in organizational, management and production activities for sustainable growth;
- to navigate in modern models, methods and approaches of assessment and forecasting of the development of society and its components;
- aggregate, evaluate, analyze, and forecast indicators of sustainable development;
- develop systems for evaluating indicators of sustainable development, including using GIS technologies and multiprocessor cluster computing platforms;
- create an intelligence map - the implementation of a common technology of creative thinking;
- to navigate in approaches and effective measures to increase the sustainability of projects and existing facilities and systems;
- using scientific and technical information, regulatory documents, and professional knowledge to offer permanent solutions in the field of ICT and related to it.

2. Prerequisites and post requisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

The study of the discipline is based on the students' knowledge of the fundamental concepts of chemistry, physics, mathematics, economics, sociology, ecology and it is aimed at developing the skills of a systematic approach to studying and solving the problems of sustainable development, as well as the ability to correctly assess the local and distant consequences of the decisions made.

The discipline is closely related to the discipline "Scientific work on the topic of the master's dissertation" as it aims to develop skills of a systematic approach to the study and solution of sustainable development problems, and the ability to properly assess the local and long-term effects of decisions on the direct and indirect effects of human activities on the environment. The obtained competencies are used during the master's dissertation.

3. The content of the discipline

Topic 1 Problems of sustainable development

Topic 2 Modeling and assessment of the sustainability of society's development

Topic 3 Innovative sustainable growth

Topic 4 Information and communication aspects of sustainable development

4. Training materials and resources

Basic literature

1. Kononenko O.Yu. Actual problems of sustainable development: educational and methodological manual. O. Yu. Kononenko. K.: SE "Print Service", 2016. 109 p. (in Ukrainian)
Kononenko O.lu. Aktualni problemy staloho rozvytku: navchalno- metodychnyi posibnyk. O.lu. Kononenko. K.: DP «Print servis», 2016. 109 s.
URL: http://www.geo.univ.kiev.ua/images/doc_file/navch_lit/posibnik_Kononenko.pdf
2. Sustainable innovative development: Methodological guidelines for conducting seminars, completing individual tasks and independent work for students of the second (master's) level of training in all specialties [Electronic resource] / [comp. Bendyug V. I., Komarista B. M.]. - K: 2017. - 127 p. (in Ukrainian)
Stalyi innovatsiyni rozvytok: Metodychni vkazivky do provedennia seminarskykh zaniat, vykonannia individualnogo zavdannia i samostiinoi roboty dlia studentiv druhoho (mahisterskoho) rivnia pidhotovky usikh spetsialnosti [Elektronnyi resurs] / [uklad. Bendyuh V. I., Komarysta B. M.]. – K: 2017. – 127 s.
URL: <https://ela.kpi.ua/handle/123456789/19692>
3. Sustainable development of society. Study guide - Sustainable development of society: study guide. author: A. Sadovenko, L. Maslovska, V. Sereda, T. Tymochko. 2 species K.; 2011. (in Ukrainian)
Stalyi rozvytok suspilstva. Navchalnyi posibnyk - Stalyi rozvytok suspilstva: navchalnyi posibnyk. avt.: A. Sadovenko, L. Maslovska, V. Sereda, T. Tymochko. 2 vyd. K.; 2011.
URL: <http://sd4ua.org/stalyj-rozvytok-suspilstva-navchalnyj-posibnyk-stalyj-rozvytok-suspilstva-navchalnyj-posibnyk-avt-a-sadovenko-l-maslovska-v-sereda-t-tymochko-2-vyd-k-2011-392-s/>
4. Sustainable development. A short terminological dictionary for masters of all fields of study [Text] / Compiler: M. Z. Zgurovsky, G. O. Statyukha, I. M. Dzhyhyrey. – K.: NTUU "KPI", 2008. – 52 p. (in Ukrainian, G.I. Denisenko STL)
Stalyi rozvytok. Korotkyi terminolohichnyi slovnyk dlia mahistriv usikh napriamiv pidhotovky [Tekst] / Uklad.: M. Z. Zghurovskiyi, H. O. Statiukha, I. M. Dzhyhyrei. – K.: NTUU "KPI", 2008. – 52 s. (NTB im. H.I. Denysenka)
5. Sustainable innovative development. Analysis, modeling and forecasting of the development of society: Visualization of indicators of sustainable development [Electronic resource]: training. manual for master's degree holders / Igor Sikorsky KPI; editor: I. M. Dzhyhyrey. – Electronic text data (1 file: 0.98 MB). – Kyiv: KPI named after Igor Sikorskyi, 2022. – 28 p. (in Ukrainian)
Stalyi innovatsiyni rozvytok. Analiz, modeliuвання i prohnozuvannya rozvytku suspilstva: Vizualizatsiia pokaznykiv staloho rozvytku [Elektronnyi resurs] : navch. posib. dlia zdobuvachiv stupenia mahistra / KPI im. Ihoria Sikorskoho ; uklad.: I. M. Dzhyhyrei. – Elektronni tekstovi danni (1 fail: 0,98 Mbait). – Kyiv : KPI im. Ihoria Sikorskoho, 2022. – 28 s.
6. Sustainable innovative development: Web application ArcGIS Online [Electronic resource]: training. manual for master's degree holders / Igor Sikorsky KPI; edited by: V. V. Putrenko, I. M. Dzhyhyrey. – Electronic text data (1 file: 1.61 MB). – Kyiv: Igor Sikorsky KPI, 2022. – 41 p. (in Ukrainian)
Stalyi innovatsiyni rozvytok: Vebzastosunok ArcGIS Online [Elektronnyi resurs] : navch. posib. dlia zdobuvachiv stupenia mahistra / KPI im. Ihoria Sikorskoho ; uklad.: V. V. Putrenko, I. M. Dzhyhyrei. – Elektronni tekstovi dani (1 fail: 1,61 Mbait). – Kyiv : KPI im. Ihoria Sikorskoho, 2022. – 41 s.

Додаткова література

(факультативно / ознайомлення)

1. Marolla C. Information and Communication Technology for Sustainable Development. CRC Press, 2018. — 272 p. (за запитом викладачу)
2. Analysis of sustainable development — global and regional contexts / International. science council (ISC), etc.; of science driver project of M.Z. Zgurovskiyi. — K.: Igor Sikorsky KPI, 2019. — Part 1. Global analysis of the quality and security of life (2019). — 216 p. (in Ukrainian)
Analiz staloho rozvytku — hlobalnyi i rehionalnyi konteksty / Mizhnar. rada z nauky (ISC) ta in.; nauk. ker. proektu M. Z. Zghurovskiyi. — K. : KPI im. Ihoria Sikorskoho, 2019. — Ch. 1. Hlobalnyi analiz yakosti i bezpeky zhyttia (2019). — 216 s.
URL: <http://wdc.org.ua/sites/default/files/SD2019-P1-FULL-UA.pdf>
3. Analysis of sustainable development — global and regional contexts / International. science council (ISC), etc.; of science driver project of M.Z. Zgurovskiyi. — K.: Igor Sikorsky KPI, 2019. — Part 2. Ukraine in indicators of sustainable development (2019). — 112 p. (in Ukrainian)
Analiz staloho rozvytku — hlobalnyi i rehionalnyi konteksty / Mizhnar. rada z nauky (ISC) ta in.; nauk. ker. proektu M. Z. Zghurovskiyi. — K. : KPI im. Ihoria Sikorskoho, 2019. — Ch. 2. Ukraina v indyktorakh staloho rozvytku (2019). —

- 112 s.
URL: <http://wdc.org.ua/sites/default/files/SD2019-P2-FULL-UA.pdf>
4. Danylyshyn, B.M. Economics of nature use: a textbook / Danylyshyn B.M., Khvesyuk M.A., Golyan V.A. - K.: Kondor, 2010. - 465 p. (in Ukrainian, at the lecturer's request)
Danylyshyn, B.M. Ekonomika pryrodokorystuvannya: pidruchnyk / Danylyshyn B.M., Khvesyuk M.A., Holian V.A. - K.: Kondor, 2010. - 465 s.
 5. Voitko S. V. Project and startup management in Industry 4.0: textbook / S. V. Voitko. – Kyiv: Igor Sikorsky KPI, 2019. – 200 c. (in Ukrainian)
Voitko S. V. Upravlinnia proektamy ta startapamy v Industrii 4.0 : pidruchnyk / S. V. Voitko. – Kyiv : KPI im. I. Sikorskoho, 2019. – 200 c.
URL: <https://books.google.com.ua/books?id=k1afDwAAQBAJ>
 6. Zgurovsky, M. Z. Fundamentals of sustainable development of society [Text]: a course of lectures in 2 hours / M. Z. Zgurovsky, G. A. Statyuha. - K.: NTUU "KPY", 2010. - Part 1. - 464 p. (in Ukrainian, G.I. Denisenko STL)
Zghurovskiy M. Z. Osnovy ustoichyvoho rozvytyia obshchestva [Tekst]: kurs lektsiy v 2 ch. / M. Z. Zghurovskiy, H. A. Statiukha. – K.: NTUU «KPY», 2010. – Ch. 1. – 464 s.
 7. Podlisniuk, V.V. Sustainable development of society: 25 questions and answers. V.V. Podlisnyuk Interpretive guide. K.: Polygraph Express, 2001. 28 p. (in Ukrainian, at the lecturer's request)
Pidlisniuk, V.V. Stalyi rozvytok suspilstva: 25 zapytan ta vidpovidei. V.V. Podlisniuk. Tlumachnyi posibnyk. K.: Polihraf-ekspres, 2001. 28 s.
 8. Risk management of sustainable development of energy sector: information support for decision-making: training manual / N. V. Karaeva, S. V. Voitko, L. V. Sorokina. — K.: Alfa Reklama, 2013. — 308 p. (in Ukrainian, at the lecturer's request)
Ryzyk-menedzhment staloho rozvytku enerhetyky: informatsiina pidtrymka pryiniattia rishen : navch. posibn. / N. V. Karaeva, S. V. Voitko, L. V. Sorokina. — K. : Alfa Reklama, 2013. — 308 s.
 9. Socio-economic potential of sustainable development: textbook for students. universities L.G. Melnyk (scientific editor), L. Hans (scientific editor). Sumy: ITD "Universitetskaya kniga", 2007. 1120 p. (in Ukrainian, at the lecturer's request)
Sotsyalno-ekonomycheskyi potentsyal ustoichyvoho rozvytyia: uchebnyk dlia stud. vuzov. L.H. Melnyk (nauch. red.), L. Khens (nauch. red.). Sumy: YTD "Unyversytetskaia knyha", 2007. 1120 s.
 10. Sustainable development: ecological and economic optimization of territorial production systems: education. village / N.V. Karaeva, R.V. Korpan, T.A. Kotsko et al. / In general ed. I.V. Nedina – Sumy: VTD "University Book", 2008. - 384 p. (in Ukrainian, at the lecturer's request)
Stalyi rozvytok: ekoloho-ekonomichna optymizatsiia terytorialno-vyrobnychkykh system: navch. pos. / N.V. Karaeva, R.V. Korpan, T.A. Kotsko ta in. / Za zah. red. I.V. Nedina. – Sumy: VTD «Unyversytetska knyha», 2008. - 384 s.
 11. Foresight of the economy of Ukraine: medium-term (2015–2020) and long-term (2020–2030) time horizons / Sci. Project manager Acad. National Academy of Sciences of Ukraine M.Z. Zgurovsky / International Council for Science (ICSU); System Analysis Committee at the Presidium of the National Academy of Sciences of Ukraine; National Technical University of Ukraine "Kyiv Polytechnic Institute"; Institute of Applied System Analysis of the National Academy of Sciences of Ukraine and the Ministry of Education and Science of Ukraine; World Data Center for Geoinformatics and Sustainable Development. — Kyiv: NTUU "KPI", 2015. (in Ukrainian)
Forsait ekonomiky Ukrainy: serednostrokovyi (2015–2020 roky) i dovhostrokovyi (2020–2030 roky) chasovi horizonty / nauk. Kerivnyk proektu akad. NAN Ukrainy M. Z. Zghurovskiy / Mizhnarodna rada z nauky (ICSU); Komitet iz systemnoho analizu pry Prezhydii NAN Ukrainy; Natsionalnyi tekhnichnyi universytet Ukrainy «Kyivskiy politekhnichnyi instytut»; Instytut prykladnoho systemnoho analizu NAN Ukrainy i MON Ukrainy; Svitovyi tsentr danykh z heoinformatyky ta staloho rozvytku. — Kyiv: NTUU «KPI», 2015.
URL: <http://wdc.org.ua/sites/default/files/WDC-IASA-FORSIGHT-UA.pdf>
 12. Sustainable development: theory, methodology, practice: textbook / Ed. Prof. L.G. Melnyka - Sumy, 2009. - 1216 p. (in Ukrainian, at the lecturer's request)
Ustoichyvoe rozvytye: teoriya, metodolohiya, praktyka : uchebnyk / pod red. prof. L.H. Melnyka. – Sumy, 2009. – 1216 s.
 13. Schwab K. The fourth industrial revolution. Forming the fourth industrial revolution: a monograph / trans. from English N.V. Klymchuk, Ya.A. Lebedenko. Kharkiv, 2019. 416 p. (in Ukrainian, at the lecturer's request)
Shvab K. Chetverta promyslova revoliutsiia. Formuiuchy chetvertu promyslovu revoliutsiiu: monohrafiia / per. z anhl. N.V.Klymchuk, Ya.A.Lebedenko. Kharkiv, 2019. 416 s.

Інформаційні ресурси

Sustainable development knowledge platform [Electron. resource] / UN. – Access link:

<https://sustainabledevelopment.un.org>

The Eco-Innovation Observatory [Electron. resource] / EC. – Access link: <http://www.eco-innovation.eu>

UN publications in Ukraine [Електрон. ресурс] / UN in Ukraine. – Access link: <http://www.un.org.ua/ua/publikatsii-ta-zvityi/un-in-ukrainepublications> (in Ukrainian)

UNDP publications in Ukraine [Електрон. ресурс] / UNDP in Ukraine. – Access link: <https://issuu.com/undpukraine> (in Ukrainian)

Sustainable development for Ukraine [Електрон. ресурс]. – Access link: <http://sd4ua.org> (in Ukrainian)

5. Methods of mastering the discipline (educational component)

The educational discipline includes 18 hours of lectures and 18 hours of seminar classes, as well as the completion of a modular control work, which consists of four parts on the topics of the educational discipline with a duration of 0.5 acad. hours each.

Seminar classes on the discipline are held with the aim of consolidating the theoretical provisions of the academic discipline "Sustainable Innovative Development" and students acquiring the skills and experience to operate with modern concepts in the field of sustainable innovative development, which are necessary for the correct perception of the direction of social progress and ensuring safe conditions for the existence of humanity in the future, under the guidance of the teacher through the preparation and discussion of appropriately formulated questions of seminar classes. Based on the distribution of time for studying the discipline, nine seminar classes are recommended (taking into account the time for the modular test and assessment).

**Deadline
(week)**

Titles of sections and topics

Topic 1. Problems of sustainable development	
1	Lecture 1. Principles, concepts and current problems of sustainable development and social and economic security
2	Seminar session 1. General issues of sustainable development
3	Lecture 2. Modern views on climate change
4	Seminar class 2. Climate changes in the reports of international organizations
5	Lecture 3. Problems of information society and innovative development. Globalization and global threats of a social, economic, environmental, geopolitical and technological nature
6	Seminar lesson 3. Globalization and global problems of sustainable growth <i>Modular test (part I)</i>
Topic 2. Modeling and assessment of the sustainability of society's development	
7	Lecture 4. Metrics and indicators of social development
8	Seminar lesson 4. Targets and indicators of sustainable development goals in international agreements, reports and networks
9	Lecture 5. Methods and approaches of multidimensional data analysis and forecasting for sustainable development
10	Seminar lesson 5. Analysis, modeling and foresight of the development of society. <i>Modular test (part II)</i>
Topic 3. Innovative sustainable growth	
11	Lecture 6. Low-carbon growth in the context of the new industrial revolution. Energy-saving technologies and infrastructure solutions.
12	Seminar class 6. Product life cycle assessment
13	Lecture 7. Circular economy
14	Seminar lesson 7. Risk management and innovative risks <i>Modular test (part III)</i>
Topic 4. Information and communication aspects of sustainable development	
15	Lecture 8. The role of ICT in the eco-development of urban areas
16	Seminar lesson 8. Innovations for sustainable development in the field of <i>software for multimedia and information retrieval systems</i>
17	Lecture 9. ICT "revolution" in the context of sustainable development
18	Seminar session 9. Use of GIS technologies in the assessment of indicators of sustainable development. <i>Modular test (part IV)</i>

6. Students' self studying

The student's self work includes such components as preparation for current surveys, preparation for seminar classes, in particular: preparation of a report and joint report, electronic short informational reports within the deadline specified by the teacher, preparation for a modular control work.

Policy and control

7. Policy of academic discipline (educational component)

Attending classes. *Absence does not result in penalty points. The final rating score of the student is formed solely based on evaluation of learning outcomes. At the same time, the discussion of the results of the thematic tasks, as well as the presentation / public speech and participation in the discussions and additions to the seminars will be evaluated during the classroom sessions.*

To actively participate in the seminar, the student prepares for a particular seminar using the literature recommended by the lecturer. Participation in the seminar also involves the preparation of reports and co-reports within all classes.

Missed evaluation control measures. Each student has the right to work out missed for a good reason (sick leave, mobility, etc.) classes through independent work. Details on the link: <https://kpi.ua/files/n3277.pdf>.

Procedure for appealing the results of evaluation control measures. The student can raise any issue related to the control procedure and expect it to be considered according to predefined procedures. Students have the right to challenge the results of control measures, explaining which criterion they do not agree with according to the assessment.

Calendar control is carried out to improve the quality of student learning and monitor student compliance with syllabus requirements.

Criterion		First calendar control	Second calendar control
Term of calendar control		Week 8	Week 14
Conditions for obtaining a positive assessment	Current rating	≥ 10 points	≥ 30 points

Academic integrity. The policy and principles of academic integrity are defined in Section 3 of the Code of Honour of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Details: <https://kpi.ua/code>.

Norms of ethical behaviour. Norms of ethical behaviour of students and employees are defined in Section 2 of the Code of Honour of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute".

Inclusive education. The acquisition of knowledge and skills during the study of the discipline "Foundations of Sustainable Development" may be available to most people with special educational needs, except for students with severe visual impairments who do not allow to perform tasks with personal computers, laptops, and/or other technical means.

Learning a foreign language. During the assignments, students may be encouraged to refer to Ukrainian-language sources.

Assignment of incentive and penalty points. According to the Regulations on the system of assessment of learning outcomes, the sum of all incentive points may not exceed 10% of the rating scale.

Criterion	Incentive points		Penalty points	
	Weighting points	Criterion	Weighting points	Criterion
Writing abstracts, articles, registration of course work as a scientific work for participation in the competition of student research papers (on the subject of the discipline)	5-10 points	-	-	-
Participation in international, all-Ukrainian, and/or other events and/or competitions (on the subject of academic discipline)	5-10 points	-	-	-

Preparation for seminars and control activities is carried out during the self students studying with the possibility of consulting with the teacher at a certain time of consultations or using e-mail and messengers.

8. Types of control and rating system for assessing learning outcomes (RSA)

Semester certification is conducted in the form of a test. A 100-point rating system and a university scale are used to assess learning outcomes.

Current control: frontal surveys, participation in seminars, reports, electronic reporting, modular test.

Calendar control is conducted twice a semester for monitoring of the current state of compliance with the requirements of the syllabus.

Semester control: test.

If the semester rating is more than 60 points, the student may not go to the test, and get a grade "automatically".

List of control measures

№	Evaluation control measure	Weighting points	Amount	Total
1	Report at the seminar	9	2	18
2	Co-report at the seminar	4	2	8
3	Participation in the work of the seminar	2	8	16
4	Frontal survey based on lecture material	2	8	16
5	Preparation of an electronic report	5	2	10
6	Part of the modular control work on a certain topic of the discipline	8	4	32
	Total		23	100

Evaluation system of control measures

Component	Evaluation system
1	<i>Preparation of a report on a given topic is assessed at 9 points: "excellent", creative disclosure of the task, fluency in the material - 9 points; "good", deep disclosure of the task - 7-8 points; "satisfactory", justified disclosure of the task - 6 points. During the semester, each student prepares two speeches based on the number of students in a group of 15 people.</i>
2	<i>The co-presentation (opposition) is evaluated at 4 points: "excellent", fluency in the material, well-founded and reasoned questions, remarks and comments - 4 points; "good", mastery of the material - 3 points; "satisfactory", weak mastery of the material - 2 points. During the semester, each student acts as a co-speaker twice.</i>
3	<i>Participation in the work of the seminar is assessed at 2 points: active work at the seminar is assessed at 2 points, less active participation, incorrect questions and comments that indicate the student's unpreparedness for the class reduce the grade for the work at the seminar to 1 point or to 0 points.</i>
4	<i>The frontal survey based on the content of the lecture session is valued at 2 points: 2 points if the student answered all the questions correctly; 1 point if there were minor errors in the answers or the answers were incomplete; 0 points - most answers are incorrect, incomplete or missing.</i>
5	<i>The preparation of electronic reports based on the results of self-mastery of the SDI web service (WDC-Ukraine) and ArcGIS cloud services (Esri), the creation of an intelligence map are rated at 5 points: "excellent", creative disclosure of the task, fluency in the material - 5 points; "good", deep disclosure of the task - 4 points; "satisfactory", justified disclosure of the task - 3 points.</i>
6	<i>Each of the four parts of the modular test contains eight complex questions of the test, calculation or open (a question that requires an extended text response) type, which are evaluated for one point. A student receives 1 point for a correct answer to a question, 0 points for an incorrect answer.</i>

To receive credit for the discipline "automatic", one need to have a rating of at least 60 points, as well as one report and one co-report presented by the student in seminar classes, and at least one electronic report. Students who at the end of the semester have a rating of less than 60 points or who have not met other conditions for receiving a credit in the academic discipline "automatically", as well as those who want to improve their grade, perform a credit control work. There are two options for completing the credit test at the student's choice.

Option 1. The credit control work is performed on the distance learning platform for 2 academic hours and contains 120 closed test and open questions of different difficulty levels with weighting points from 0.5 to 2, the sum of which is 100 points.

Option 2. A written assessment test, the tickets of which contain four questions of a theoretical, systematic and calculation-analytical nature on each of the four topics of the academic discipline, is completed within 2 academic hours. Each question is valued at 25 points: "excellent", creative, systematic and complete disclosure of the question, fluency in the material - 24-25 points; "very good", disclosure of the question, fluency in the material - 21-23 points; "good", sufficient disclosure of the question, mastery of the material - 19-20 points; "satisfactory", reasonable disclosure of the question, incomplete mastery of the material - 17-18 points; "enough", partial disclosure of the question - 15-16 points.

Table of correspondence of rating points to grades on the university scale:

Points	Mark
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactory
64-60	Enough
Less than 60	Unsatisfactory

9. Additional information on the discipline (educational component)

The list of questions submitted for semester control is presented in Appendix A.

Teaching methods and forms include not only traditional university lectures and seminar activities, but also elements of teamwork, brainstorming and group discussions. Active learning strategies are applied, which are determined by the following methods and technologies: problem-based learning methods (research method); personal-oriented technologies based on such forms and methods of learning as case technology and project technology; visualization and information and communication technologies, including electronic presentations for lectures. Communication with the teacher is built using the "Electronic Campus" information system, the "Sikorsky" distance learning platform, as well as such communication tools as the teacher's web resource, e-mail, Telegram messenger. During training and for interaction with students, modern information and communication and network technologies are used to solve educational tasks.

Elective training. *For a better understanding of the principles, principles, and tools of sustainable engineering and technology, it is recommended to take online courses via web links*

1. <https://coursera.org/learn/sustainable-development>
 2. <https://coursera.org/learn/global-sustainable-development>
 3. <https://coursera.org/learn/responsible-management>
 4. <https://coursera.org/learn/global-sustainability-be-sustainable>
 5. <https://coursera.org/learn/sdgbusiness>
 6. <https://coursera.org/learn/corp-sustainability>
 7. <https://coursera.org/learn/business-case-sustainability>
 8. <https://coursera.org/learn/sustainability-through-soccer>
 9. <https://coursera.org/learn/greening-the-economy>
 10. <https://coursera.org/learn/sustainability>
- and others.*

Assessment for control measures is possible by transferring the results of passing the specified and other online courses in accordance with the Regulations on the Procedure for Recognition of Study Results

Acquired by Students of Igor Sikorsky KPI in non-formal / informal education (<https://osvita.kpi.ua/node/179>).

Working program of educational discipline (syllabus):

Developed by:

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Adopted by Computer Systems Software Department (protocol № 12 from 26.04.23)

Approved by the Faculty Board of Methodology (protocol № 10 from 26.05.23)

List of questions to be submitted for semester control:

- *21st century enterprise;*
- *Agenda 2030 and sustainable development goals for 2016-2030;*
- *aggregation of social development indicators;*
- *Bellagio principles;*
- *carbon footprint;*
- *circular economy;*
- *classification of sustainable development evaluation systems according to Ness;*
- *models of formation of sustainable development indicator systems;*
- *decoupling concept;*
- *definition of the concept of sustainable development, principles of sustainable development;*
- *differences in final technologies and cleaner production;*
- *dimensions and components of sustainable development;*
- *eco-efficiency, X factor;*
- *ecological footprint and biocapacity;*
- *ecologically and socially adjusted national economic indicators;*
- *energy management system and family of ISO 50000 standards;*
- *enterprise risk management and the ISO 31000 family of standards;*
- *environmental engineering and environmental technology;*
- *environmental labeling;*
- *environmental management system and family of ISO 14000 standards;*
- *Environmental Performance Index;*
- *environmental, economic and social approaches and strategies of sustainable development in the technological dimension;*
- *environmental, economic and social principles of sustainable development in the technological dimension;*
- *final document of Rio+20 "The future we want"*
- *FL-activity (prospective research);*
- *foresight cycle and foresight diamond*
- *general, providing and supporting goals of sustainable development;*
- *global climate change in international documents and reports;*
- *global problems of society development;*
- *greenhouse gases and anthropogenic factors of climate change;*
- *GSDR "The Future is Now: Science for Achieving Sustainable Development" (UN, 2019);*
- *Happy Planet Index;*
- *High-level political forum on sustainable development;*
- *human development indices of the United Nations Development Program;*
- *inclusive sustainable industrial development;*
- *industrial ecology and eco-industrial symbiosis;*
- *integrated sustainable waste management;*
- *internalization of externalities;*
- *IPCC reports of the Sixth assessment cycle;*
- *key events and documents in the field of climate change;*
- *key events and documents in the field of sustainable development;*
- *Kyoto Protocol to the UNFCCC;*
- *Living Planet Index;*
- *low-carbon innovations;*
- *Millennium Declaration and global Millennium Development Goals;*

- *models of development of Society and Nature (weak sustainability, three-pillar, strong sustainability);*
- *national sustainable development goals;*
- *new technologies and advanced digital production;*
- *Paris (climate) agreement of 2015;*
- *planetary boundaries;*
- *prerequisites for the emergence of the concept of sustainable development;*
- *renewable and non-renewable resources, renewable energy (modern world and national state and trends);*
- *report "Our Common Future" of the World Commission on Environment and Development;*
- *resource-efficient and cleaner production;*
- *scenario component of foresight studies;*
- *social responsibility and the ISO 26000 standard;*
- *sustainable production, sustainable consumption and responsible care;*
- *System of Environmental Economic Accounting;*
- *technologies, methods and approaches for climate change mitigation*
- *the concept of a smart city;*
- *UN Framework Convention on Climate Change;*
- *World Energy Trilemma-Index*