



# FOUNDATIONS OF SUSTAINABLE DEVELOPMENT

## Working program of educational discipline (syllabus)

### Requisites of educational discipline

Higher education level	<i>Second (master)</i>
Knowledge domain	<i>For all domains</i>
Speciality	<i>For all specialities</i>
Educational program	<i>For all educational programs</i>
Status of the discipline	<i>Normative</i>
Form of education	<i>Part-time</i>
Year of preparation, semester	<i>I course, autumn / spring semester</i>
Teaching hours	<i>60 hours / 2 credits ECTS (lections – 4 hours, seminars – 4 hours, self-studying – 52 hours)</i>
Semester control / control activities	<i>Semester test, home control work</i>
Schedule	<i><a href="https://schedule.kpi.ua/">https://schedule.kpi.ua/</a></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 AI Dzhygyrey Iryna Mykolaivna, lab.mes@kpi.ua</i>
Course link	<i><a href="https://do.ipk.kpi.ua/course/view.php?id=4172">https://do.ipk.kpi.ua/course/view.php?id=4172</a></i>

### Program of educational discipline

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

*Sustainable development is a broad concept of societal progress, emphasizing the need to balance current human needs with protecting the interests of future generations, particularly their need for a safe and healthy environment. Sustainable engineering, as a strategy within sustainable development, serves as a means to integrate sustainability principles into the curricula of future professionals. According to UNESCO, sustainable engineering necessitates an interdisciplinary approach across all aspects of engineering. Incorporating sustainability into engineering practices enhances the quality of life for all individuals. This discipline, one of the newest educational courses, employs an interdisciplinary and systematic approach to examining key issues in human interaction with the environment, advancements in modern living, and technology development through the lens of sustainable principles.*

*The **purpose** of mastering the discipline is to develop learners' competencies in applying the principles and approaches of sustainable development in the technological dimension, essential for integrating sustainability concepts into engineering and technical activities, aimed at creating and implementing innovative environmentally and socially responsible solutions.*

*The **subject** of the discipline encompasses organizational solutions in sustainable engineering and technology, including algorithms for enterprise policy and goal-setting, workplace organization, and safety measures. This approach contributes to enhanced living conditions, rational utilization of natural resources, and more environmentally friendly and sustainable development.*

*After mastering the discipline, learners (degree-seeking students) must demonstrate the following learning outcomes:*

- demonstrate awareness of the state and current trends in the development of global society in the context of sustainable development, approaches and effective measures for increasing the sustainability of projects and existing objects and systems;*
- determine directions, develop and implement modernization projects for the production of micro- and nanosystem equipment, taking into account technical, economic, legal, social and environmental aspects.*

## **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 builds on learners' knowledge of key concepts in physics, mathematics, economics, sociology, ecology, and training disciplines. It aims to develop skills in systematically approaching the study and resolution of sustainable development problems and engineering techniques in technology, as well as the ability to accurately assess both local and long-term environmental impacts of decisions.*

*The discipline is closely linked to the components "Scientific work on the topic of a master's thesis" in educational and scientific programs and "Execution of a master's thesis" in educational and professional programs. It focuses on fostering systematic approaches to studying and solving sustainable development challenges while assessing the direct and indirect environmental consequences of human activities. These competencies are applied during the completion of the master's dissertation.*

## **3. The content of the discipline**

**Topic 1** *The Latest Provisions of the Concept of Sustainable Development*

**Topic 2** *Economic, Social, and Environmental Challenges in the Modern World*

**Topic 3** *Sustainability Analysis of Societal Development*

**Topic 4** *Sustainable Development from a Technological Perspective:  
Strategies and Standards for Green Growth*

## **4. Training materials and resources**

### **Basic literature**

1. Foundations of sustainable development. Common issues of sustainable development. Seminar class [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute ; comp. Dzhygyrey I. M., Verlan A. A. – Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 58 p. – Access link: <https://ela.kpi.ua/items/aca06714-df19-41b0-b961-e95e943d8d9b>
2. Environmentally sustainable industrial development. Edited by Shatokha V., Stalinskiy D., Coole T., De Lepeleer G., Karpash M., Kruhlenko L., Petrenko A., Saey P., Shvets I. – Dnipro: Driant, 2017. – 317 p. (the Denysenko Scientific and Technical Library)
3. Sustainable Development Analysis: Global and Regional Contexts / International Council for Science (ISC) and others; Scientific Supervisor of the Project M. Zgurovsky. — K.: Igor Sikorsky KPI, 2019. — P. 1. Global Analysis of Quality and Security of Life (2019). — 328 p. – Access link: <http://wdc.org.ua/sites/default/files/SD2019-P1-FULL-EN.pdf>
4. Sustainable Development Goals Ukraine. 2020 Voluntary National Review / MDETA, 2020. – Access link: [https://sustainabledevelopment.un.org/content/documents/26294VNR\\_2020\\_Ukraine\\_Report.pdf](https://sustainabledevelopment.un.org/content/documents/26294VNR_2020_Ukraine_Report.pdf)
5. Times of Crisis, Times of Change: Science for Accelerating Transformations to Sustainable Development. Global Sustainable Development Report / UN, 2023. - Access link: [https://sdgs.un.org/sites/default/files/2023-09/FINAL%20GSDR%202023-Digital%20-110923\\_1.pdf](https://sdgs.un.org/sites/default/files/2023-09/FINAL%20GSDR%202023-Digital%20-110923_1.pdf)

### **Additional literature**

*(elective / familiarization)*

1. AR6 Synthesis Report: Climate Change / IPCC, 2023. – Access link: <https://www.ipcc.ch/report/sixth-assessment-report-cycle/>
2. CP Toolkit (English) / UNIDO. – Access link: <https://www.unido.org/resources/publications/safeguarding-environment/industrial-energy-efficiency/cp-toolkit-english>

3. Eco-Industrial Parks: Achievements and Key Insights from the Global RECP Programme 2012-2018 / UNIDO, 2019. – Access link: [https://www.unido.org/sites/default/files/files/2019-02/UNIDO\\_EIP\\_Achievements\\_Publication\\_Final\\_0.pdf](https://www.unido.org/sites/default/files/files/2019-02/UNIDO_EIP_Achievements_Publication_Final_0.pdf)
4. Filho, Walter & Țîrcă, Diana-Mihaela & Al-Amin, Abul. (2017). Sustainable Economic Development: Green Economy and Green Growth. 10.1007/978-3-319-45081-0. (Available via SpringerLink only on the local network of the Igor Sikorsky Kyiv Polytechnic Institute; the Denysenko Scientific and Technical Library)
5. Melnyk, L., Dehtyarova, I., Matsenko, O. Social and economic trends of sustainable development in the conditions of digital economy/ Role of science and education for sustainable development. Monograph. Edited by Magdalena Wierzbik-Strońska and Iryna Ostopolets/Publishing House of University of Technology, Katowice, 2021. P 31-38. <https://essuir.sumdu.edu.ua/handle/123456789/87169>
6. Narkhede, Pasi, Rajhans, Kulkarni. (2024). Industry 5.0 and sustainable manufacturing: a systematic literature review Industry 5.0 and SM. Benchmarking: An International Journal. 32. 1463-5771. 10.1108/BIJ-03-2023-0196.
7. Okhrimenko, O. O. Social responsibility: lecture notes [Electronic resource] : Teaching manual for the students Specialty 051 "Economics" / O. O. Okhrimenko, T. V. Ivanova ; Igor Sikorsky Kyiv Polytechnic institute. – Electronic text data (1 file: 4,9 MB). – Kyiv : Igor Sikorsky Kyiv Polytechnic institute, 2020. – 182 p. – <https://ela.kpi.ua/handle/123456789/33657>
8. Peris-Ortiz, Marta & Bennett, Dag & Yabar, Diana. (2017). Sustainable Smart Cities: Creating Spaces for Technological, Social and Business Development. 10.1007/978-3-319-40895-8. (Available via SpringerLink only on the local network of the Igor Sikorsky Kyiv Polytechnic Institute; the Denysenko Scientific and Technical Library)
9. Rame, Purwanto, Sudarno. (2024). Industry 5.0 and sustainability: An overview of emerging trends and challenges for a green future. Innovation and Green Development. 3. 4. 100173. ISSN 2949-7531. 10.1016/j.igd.2024.100173.
10. Stark, Rainer & Bonvoisin, Jeremy. (2017). Sustainable Manufacturing, Challenges, Solutions and Implementation Perspectives. 10.1007/978-3-319-48514-0. (Available via SpringerLink only on the local network of the Igor Sikorsky Kyiv Polytechnic Institute; the Denysenko Scientific and Technical Library)
11. Sustainable Development Goals: Ukraine. National baseline report / MEDT, 2017. Access link: <https://me.gov.ua/Documents/Download?id=05822f66-290b-4b51-a392-347e76ebeb5f>
12. The Global Risks Report 2024. 19th Edition / WEF, 2024. – Access link: [https://www3.weforum.org/docs/WEF\\_The\\_Global\\_Risks\\_Report\\_2024.pdf](https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2024.pdf)
13. Transnational Corporations. Educational textbook [Electronic Resource] / S. V. Voitko, O. A. Gavrish, O. O. Korohodova, T. E. Moiseenko ; Igor Sikorsky Kyiv Polytechnic Institute. – Electronic text data (1 file: 2.89 MB). - Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2020. – 204 p. – <https://ela.kpi.ua/handle/123456789/49843>
14. Weizsäcker Ernst Ulrich von, Wijkman Anders. Come On! Capitalism, Short-termism, Population and the Destruction of the Planet. A Report to the Club of Rome. — Springer Science+Business Media LLC, 2018. (on request to the lecturer)

### **Information resources**

Sustainable development [Electron. resource] / UN DSDG. – Access link: <https://sdgs.un.org/>  
 The Eco-Innovation Observatory [Electron. resource] / EC. – Access link: <http://www.eco-innovation.eu>  
 Publications UN in Ukraine [Electron. resource] / UN in Ukraine. – Access link: <https://ukraine.un.org/en/resources/publications>  
 UNDP in Ukraine [Electron. resource] / UNDP in Ukraine. – Access link: <https://www.undp.org/en/ukraine/publications>  
 Publications / the Ellen MacArthur Foundation. – Access link: <https://www.ellenmacarthurfoundation.org/publications>

## **Educational content**

### **5. Methods of mastering the discipline (educational component)**

*Seminars for the discipline are conducted to reinforce the theoretical principles of "Foundations of Sustainable Development".*

*Under the guidance of a teacher, learners acquire the skills and experience necessary to engage with modern concepts in sustainable development, ensuring proper understanding of societal progress and*

the creation of safe living conditions for future generations. This is achieved by preparing and discussing well-structured seminar topics. Based on the allocated time for studying the discipline, two seminars are recommended.

<i>Deadline (week)</i>	<i>Titles of sections and topics</i>
<b>Topic 1. The Latest Provisions of the Concept of Sustainable Development</b>	
	<b>Lecture 1.</b> Prehistory and main sustainable development concepts
	<b>Seminar 1.</b> Common issues of sustainable development
	Self-work. Globalization and global social, economic, environmental, geopolitical, and technological threats
<b>Topic 2. Economic, Social, and Environmental Challenges in the Modern World</b>	
	Self-work. Modern worldwide challenges to sustainable growth
	Self-work. Modern scientific basis of climate change
	Self-work. Key messages on climate change issue in the reports of international organizations
<b>Topic 3 Sustainability Analysis of Societal Development</b>	
	Self-work. Sustainable development metrics and indicator systems
	Self-work. Assessment of society's development
	Self-work. Aggregated evaluation and forward looking activities for sustainable development
<b>Topic 4 Sustainable Development in Technological Perspective: Strategies and Standards for Green Growth</b>	
	<b>Lecture 2.</b> Principles, approaches, strategies and systems of the technological dimension of sustainable development
	Self-work. Innovations for sustainable development
	Self-work. International standards for sustainable development
	<b>Seminar 2.</b> Environmental, energy and risk management for sustainable production
	Self-work. Inclusive and sustainable industrial development
	Self-work. Green growth and circular economy
	<b>Home test</b>

## 6. Self-studying

The self-learners studying includes preparation for seminars, report, electronic information report, information bulletin, modular control work.

<i>No</i>	<i>Type of Individual Work</i>	<i>Number of Hours</i>
1	Mastering the materials of the educational component and preparation for in-class activities	42
2	Preparation for the home control work	4
3	Preparation for the test	6
	<i>Total</i>	52

## Policy and control

### 7. Policy of academic discipline (educational component)

**Attending classes.** Attendance does not result in penalty points. The final learner rating is determined solely based on the evaluation of learning outcomes. However, classroom discussions of thematic tasks,

presentations/public speeches, and participation in seminar discussions and contributions will be evaluated. To actively participate in a seminar, learners must prepare using the literature recommended by the lecturer. Seminar participation also includes the preparation of reports and co-reports during the sessions.

**Missed evaluation control measures.** Learners have the right to independently work on missed classes due to valid reasons (e.g., sick leave, mobility). Further details are available via the link:: <https://kpi.ua/files/n3277.pdf>.

**Academic integrity.** The policy and principles of academic integrity are outlined 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 for learners and employees are specified in Section 2 of the Code of Honour of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute." Details: <https://kpi.ua/code>.

**Inclusive education.** The acquisition of knowledge and skills during the study of the discipline "Foundations of Sustainable Development" is accessible to most individuals with special educational needs, except for learners with severe visual impairments that prevent the completion of tasks using personal computers, laptops, and/or other technical means.

**Learning a foreign language.** During assignments, learners may be encouraged to reference Ukrainian-language sources.

**Assignment of incentive and penalty points.** In accordance with the Regulations on the system of assessment of learning outcomes, the total incentive points may not exceed 10% of the rating scale.

Incentive points		Penalty points	
Criterion	Weighting points	Criterion	Weighting points
Writing abstracts, articles, registration of course work as a scientific work for participation in the competition of learner 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 learners' self-study, with the option to consult with the teacher at designated consultation times or via e-mail and messaging platforms.

## 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 evaluate learning outcomes.

**Current control** includes frontal surveys, participation in seminars, reports, electronic submissions, and modular tests.

**Calendar control** is carried out twice per semester to monitor compliance with syllabus requirements.

**Semester control:** test.

If a learner achieves a semester rating exceeding 60 points, they may opt not to take the test and automatically receive a grade.

**Home control work.** The home control work contains 20 complex questions of the test, calculation or open (question that requires a detailed text answer) type, which are evaluated in one point. The learner receives 1 point for the correct answer to the question, incorrect – 0 points.



No	Evaluation control measure	%	Weighting points	Amount	Total
1.	Public report, e-reporting, e-bulletin	20%	10;5;5	3	20*
2.	Home control work	20%	20	1	20
	Total				100

\* Weighing 20 points cover three components: preparation of reports on selected topics as a speaker, electronic reporting, and the preparation of electronic bulletin.

The first component involves preparing a report on a given topic, evaluated at a maximum of 10 points: "excellent" — creative task disclosure with mastery of the material (10 points); "good" — thorough task disclosure (8-9 points); "satisfactory" — reasonable task disclosure (6-7 points). During the semester, each learner delivers one presentation, assuming a group size of 15 learners.

The electronic bulletin is evaluated out of 5 points: "excellent" — mastery of the material, with substantiated and reasoned questions, remarks, and comments (5 points); "good" — mastery of the material (4 points); "satisfactory" — limited mastery of the material (3 points). Each learner prepares one e-bulletin per semester.

The third component is an electronic report based on self-study of the application software SimaPro or the ArcGIS cloud service, evaluated at 5 points.

To earn credit for the discipline, learners must achieve a rating of at least 60 points.

There are two options for the semester test, allowing learners to choose their preferred method:

Option 1. Conducted on the distance learning platform over two academic hours, this test includes 60 closed and open questions of varying difficulty, with weights ranging from 0.5 to 2 points, totaling 60 points.

Option 2. A written test conducted within two academic hours. It consists of four theoretical, systematic, and computational-analytical questions covering the four topics of the discipline. Each question is evaluated up to 15 points: "excellent" — creative, systematic, and comprehensive disclosure with mastery of the material (15 points); "very good" — thorough disclosure of the issue with material mastery (13-14 points); "good" — sufficient disclosure with material understanding (11-12 points); "satisfactory" — reasonable but incomplete task disclosure (10 points); "enough" — partial task disclosure (9 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 for semester control is provided in Appendix A.

Teaching methods and formats include traditional university lectures and seminars, as well as elements of teamwork, brainstorming, and group discussions. Active learning strategies are employed, including problem-based learning (research methods), personality-oriented techniques based on case studies and project-based approaches, visualization methods, information and communication technologies, and electronic presentations for lectures. Communication with the teacher is facilitated through the use of the information system "Electronic Campus," the distance learning platform "Sikorsky," and

communication tools such as e-mail, Telegram, and Viber. Modern information, communication, and network technologies are utilized to support learner training and interaction.

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

Act further: Sustainable development for businesses

[https://courses.prometheus.org.ua/courses/course-v1:Prometheus+SDB101+2021\\_T1\\_EN/about](https://courses.prometheus.org.ua/courses/course-v1:Prometheus+SDB101+2021_T1_EN/about)

Sustainable Digital Innovation

<https://www.coursera.org/learn/sustainable-digital-innovation>

Introduction to Sustainability

<https://www.coursera.org/learn/sustainability>

Global sustainability and corporate social responsibility: Be sustainable

<https://www.coursera.org/learn/global-sustainability-be-sustainable>

The Sustainable Development Goals – A global, transdisciplinary vision for the future

<https://www.coursera.org/learn/global-sustainable-development>

and others.

Assessment for certain control measures may be conducted by transferring the results of completed specified online courses and others, in accordance with the Regulations on the Procedure for Recognition of Learning Outcomes 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:**

assoc. prof. the Department of Artificial Intelligence, cand. of tech. science, assoc. prof.,  
Dzhygyrey Iryna Mykolaivna

**Approved by** the Department of Artificial Intelligence (protocol № 10 of 26.03.2025)

**Agreed by** Methodical Council of the University (protocol № 8 of 29.05.2025)

*List of Questions for Semester Control:*

- *Agenda 2030 and Sustainable Development Goals for 2016–2030*
- *Aggregation of indicators of societal development*
- *Enterprise of the 21st century*
- *Bellagio principles*
- *Carbon footprint*
- *Circular economy*
- *Classification of sustainable development assessment systems*
- *Concept of a smart city*
- *Concept of decoupling*
- *Cradle-to-cradle paradigm and pollution prevention*
- *Definitions and principles of sustainable development*
- *Depletion of the ozone layer in international documents*
- *Differences between end-of-pipe technologies and cleaner production*
- *Dimensions and components of sustainable development*
- *Eco-efficiency, Factor X*
- *Ecological footprint and biocapacity*
- *Ecological labelling*
- *Energy management system and the ISO 50000 family of standards*
- *Enterprise risk management and the ISO 31000 family of standards*
- *Environmental engineering and environmental technology*
- *Environmental management system and the ISO 14000 family of 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*
- *Environmentally and socially adjusted national economic indicators*
- *Foresight cycle and foresight diamond*
- *Forward-looking activities*
- *General and supporting goals of sustainable development*
- *Global climate change in international documents and reports*
- *Global problems of societal development*
- *Greenhouse gases and the anthropogenic component in climate change*
- *Happy Planet Index*
- *High-level political forum on sustainable development*
- *Human Development Index and the Multidimensional Poverty Index*
- *Inclusive sustainable industrial development*
- *Industrial ecology and eco-industrial symbiosis*
- *Integrated sustainable waste management*
- *Internalization of externalities*
- *IPCC reports (6th synthesis report and components: "Global Warming 1.5°C," "Climate Change and Land," "Ocean and Cryosphere in a Changing World") — Key conclusions*
- *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*
- *Lean production*
- *Living Planet Index*



- *Low-carbon innovations*
- *Millennium Declaration and global Millennium Development Goals*
- *Models of development of society and nature (weak sustainability, three-pillar model, strong sustainability)*
- *Models of the formation of sustainable development indicator systems*
- *National sustainable development goals*
- *New technologies and modern digital production*
- *Paris Climate Agreement 2015*
- *Planetary boundaries*
- *Prerequisites for the emergence of the concept of sustainable development*
- *Principles of cleaner production*
- *Recycling, reuse, recovery, regeneration, remanufacturing*
- *Renewable and non-renewable resources, renewable energy (current world and national conditions and trends)*
- *Report "Our Common Future" by the World Commission on Environment and Development*
- *Report "The Future is Now: Science for Sustainable Development" (UN, 2019)*
- *Resource-efficient and cleaner production*
- *Rio+20 final document, "The Future We Strive For"*
- *Scenario component of foresight research*
- *Social responsibility and the ISO 26000 standard*
- *Sustainable production, sustainable consumption, and responsible care*
- *System of Environmental-Economic Accounting*
- *Technologies, methods, and approaches to climate change mitigation*
- *UN Framework Convention on Climate Change*
- *Waste management and pollution prevention*
- *World Energy Trilemma Index*