

GREEN COMPUTING

COURSE SYLLABUS

Code and name of specialty	122 <u>Computer Science</u>	Institute / faculty	Faculty of Computer Science and Software Engineering
Program name	«Computer Science and Intelligent Systems»	Department	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	Language of instruction	Ukrainian

Lecturer

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Doctor of Engineering Sciences, Professor, Professor of the Department of Software Engineering and Information Technologies of NTU "KhPI". Experience of pedagogical work - 23 years. Author of about 200 scientific papers, including 5 monographs, 6 textbooks and a textbook used in teaching such disciplines as "Technology Systems", "Optimization of monitoring systems", "Theory and practice of environmental management" for 10 years according to the developed textbooks, over 16 years the course "Ecology", the materials of which are provided in the textbook «Хімічна екологія : підручник–Сумський державний університет як підручник для студентів технічних ЗВО, протокол № 7 від 12.04.2018. – Суми: ПО» Видавництво «Університетська книга», 2018. – 460 с., навчальних посібниках «Основы статистического учета в экологии». Гриф МОН України, лист № 14/18.Г-1959 від 09.11.07, Стандартизація. Екологічна стандартизація і метрологія. Навч. посібник. Гриф МОН України, лист № 14/18.2-2719, від 20.12.04– 228 с. At present, the training load includes courses "Green Computer", "Statistical Analysis and Planning of Scientific Experiment", practice "Models and Methods of Decision Support", Fundamentals of Python Programming (discipline of choice 02), Advanced course of Python programming (discipline choice 02)

GENERAL DESCRIPTION OF THE COURSE

Summary	<p>The program of the discipline considers the concept of sustainable development and the ecological approach to research and use of information systems, technologies and software.</p> <p>The main objects of the discipline program are green information systems, technologies, software, digital ecosystems, software ecosystems and software as an ecosystem. The program shows how to teach students to ensure the greenness of software and information technology, how to study software ecosystems and how to apply research results in software development and maintenance.</p> <p>In the materials of lectures and laboratory works the concepts, approaches, methods directed on performance of actions in processes of a life cycle of projects, information systems and the software which will allow to speak about reception of a green software product are considered.</p>
Course objectives	study of the current state of ecological environment research theory of the from the standpoint of sustainable development, theory and practice of green information systems, technologies and software, methods and means of achieving greenery.
Types of classes and control	Lectures, laboratory work, consultations. Final control - exam

Term	7						
Student workload (credits) / Type of course	3 / Mandatory	Lectures (hours)	32	Workshops (hours)	16	Self-study (hours)	42

Program competences	<p>GC1. Ability to abstract thinking, analysis and synthesis.</p> <p>GC2. Ability to apply knowledge in practical situations.</p> <p>GC3. Knowledge and understanding of the subject area and understanding of professional activity.</p> <p>GC6. Ability to learn and master modern knowledge.</p> <p>GC8. Ability to generate new ideas (creativity).</p> <p>GC12. Ability to evaluate and ensure the quality of performed work.</p> <p>GC13. Ability to act being based on ethical considerations.</p> <p>PC6. Ability to think systematically, apply the systems analysis methodology to study complex problems of different nature, methods of formalization and solution of system problems with conflicting goals, uncertainties, and risks.</p> <p>PC10. Ability to apply methodologies, technologies, and tools to manage the life cycle processes of information and software systems, information technology products and services according to customer requirements.</p>
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Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
PLO8. Use the methodology of system analysis of objects, processes, and systems for the tasks of analysis, prediction, management, and design of dynamic processes in macroeconomic, technical, technological, and financial objects.	Interactive lectures with presentations, discussions, practical classes, teamwork, case method, method of feedback from students, problem-based learning	Written individual assignments for laboratory work (CAS), assessment of knowledge in laboratory classes (CAS), rapid surveys (CAS), online tests (CAS), final / semester control in the form of a semester exam, according to the schedule of the educational process (FAS)
PLO11. Have the skills to manage the life cycle of software, products, and services of information technology under the requirements and restrictions of the customer, be able to develop project documentation (feasibility study, technical task, business plan, agreement, contract).		

ASSESSMENT AND GRADING

Ranges of points corresponding to grades	Total score (points) for all types of learning activities	ECTS grading scale	The national grading scale	Allocation of grade points
	90-100	A	Excellent	
	82-89	B	Good	

100% final assessment as a result of final exam (40%) and continuous assessment

	74-81	C	Satisfactory	(60%). 40% final exam: ... 60% continuous assessment: ...	
	64-73	D			
	60-63	E			
	35-59	FX			Unsatisfactory (with the exam retake option)
	0-34	F			Unsatisfactory (with mandatory repetition of the course)

Course policy

The policy of the academic discipline is determined by the system of requirements for the study of the discipline, the inadmissibility of omissions, the implementation of the required minimum of educational work; incentives and penalties - scoring or subtraction of points. The policy of the academic discipline is based on the norms of the legislation of Ukraine on academic integrity, the Charter, the provisions of NTU "KhPI":

- results reduction of control work, exam;
- reassessment of control work, exam;
- appointment of additional control individual tasks, tests, tests.

COURSE STRUCTURE AND CONTENT					
Lecture 1	The concept of sustainable development, systemic solution of environmental problems. System ecology. Environmental monitoring.	Practical lesson 1-2 Laboratory work №1. Systemology of environmental research. Monitoring. Assessment of impact on environmental objects from man-made sources	System analysis of complex systems Statistical analysis	Individual work	Ecological processes and processes in them.
Lecture 2	Environmental laws. Models, methods of ecological objects research. Assessment of ecological quality of natural-technogenic complexes	Practical lesson 3-5. Work and draft report for laboratory work No. 1	System analysis of complex systems Statistical analysis		Cycle laws of substances, energy and information in ecosystems
Lecture 3	Environmental laws. Ecosystem processes. Regularities for the system "human – ecosystem – environment".	Practical lesson 6-7 Laboratory work №2. Green Computer "Green Computing". Minimum power consumption by computers, devices, their use "Ecological Method". Green Design - Energy-saving technologies for computers, servers, printers and other digital devices	System analysis of complex systems Statistical analysis		Circulation models
Lecture 4	Environmental laws. Models, methods of ecological objects research. Estimation of ecological quality of natural-technogenic complexes.	Practical lesson 8-9. Modular control 1. Laboratory work defense	System analysis of complex systems Statistical analysis		Socio-economic consequences of environmental activities
Lecture 5	Ecology of the environment: ecology of atmospheric air.	Practical lesson 10-11. Laboratory Work Report № 2	Modeling of diffusion processes		Standards and regulations for air protection
Lecture 6	Ecology of the environment: ecology of the aquatic environment.	Practical lesson 12-13. Laboratory work №3. Green Information Systems and Technology - Green IT	Physico-chemical processes of condensed media		Standards and regulations on water protection

Lecture 7	Ecology of the environment: ecology of the lithosphere.	Practical lesson 14-15. Laboratory Work Report No. 3	System analysis of complex systems		Standards and regulations for soil protection
Lecture 8	Ecologically oriented socio-economic development. Information and software of ecological productions and technologies	Practical lesson16. Laboratory work defense	System analysis of complex systems Statistical analysis		General characteristics of green computations: basic definitions and brief characteristics
Lecture 9	Green projects. Green computing		System analysis of complex systems		Characteristics of green computing
Lecture 10	Green Use - Minimum power consumption of computers, their use "Ecological Method". Green Design - Energy-saving technologies for computers, servers, printers and digital devices.		Methods of reducing energy consumption of technical devices		Utilization of waste from electronic equipment (EE).
Lecture 11	Green Manufacturing - Minimize costs for manufacturing computers and processing systems to reduce environmental impacts. Green Disposal - Re-use existing computers, environmentally friendly recycling of written off electronic equipment.		Means of security. Green manufacturing		Utilization of waste from electronic equipment (EE).
Lecture 12	Computer impact decrease on the environment: Algorithmic Efficiency; Resource Allocation; Virtualization.		Algorithmic efficiency; resource allocation; virtualization		EE waste treatment.
Lecture 13	Software as an ecosystem: Means and tasks of green software ecosystems modeling. The Green PROGRAM DESTINATIONS AND TOPICS.		The GREEN Program destinations and topics		The main trends in The GREEN Program
Lecture 14	IT branch is the main technological initiatives to reduce the impact of information on the environment.		Information resource life cycle		Initiative solutions for the development of green information technologies of global companies
Lecture 15	General trends to reduce the impact of environmental information when using information as a resource		Information resource life cycle		General measures for landscaping computer technology
Lecture 16	"Information Manufacturers" - Green IT in companies. Green IT in manufacturing for environment protection.		Green IT		waste storage and disposal

RECOMMENDED READING

1. ТОВАЖНЯНСЬКИЙ, Л. Л., МАСІКЕВИЧ, Ю. Г., МОІСЕЄВ, В. Ф. (2005). Нормування антропогенного навантаження на навколишнє природне середовище. Чернівці : Зелена Буковина.

(1991). Закон України "Про охорону навколишнього природного середовища". Відомості Верховної Ради України, 41.
2. Balamurugan Balusamy, Naveen Chilamkurti, (2020). Seifedine Kadry Green Computing in Smart Cities: Simulation and Techniques. Springer.
3. Abu Zahrim Yaser. (2020). Green Engineering for Campus Sustainability. Springer Nature Singapore Pte Ltd.
4. (2021). Computational Intelligence Methods for Green Technology and Sustainable Development Proceedings of the International Conference GTSD2020. Vol. 1284. Springer Nature Switzerland AG.
5. Kharchenko, Kondratenko Yuriy, Janusz Kacprzyk. (2019). Editors, Green IT Engineering: Social, Business and Industrial Applications Studies in Systems, Decision and Control. Volume Springer Nature Switzerland AG.
6. (2017). **ВОПРОС 8/2: Стратегии и политика, направленные на надлежащую утилизацию и повторное использование отходов, связанных с электросвязью. ИКТ Заключительный отчет. Женева.**
7. Харченко, В.С., Дрозд, А.В., Поночовный, Ю.Л., Яновская, О.В., Яновский, М.Э., Кривцов, А.Ю., Иванченко, О.В. Харченко, В. С. (ред.). (2016). Основы зеленой ИТ-инженерии. Моделирование облачных систем. Министерство образования и науки Украины, Нац. аэрокосмический ун-т им. Н.Е. Жуковского «ХАИ».
8. (2020). Зеленые финансы для зеленых проектов и зеленых технологий как сегмент рынка НТИ «ЭКОНЕТ». Retrived from: <https://spbcleantechcluster.nethouse.ru/posts/zelenye-finansy-dlia-zelenykh-proektov-i-zelenykh-tekhnologii>
9. Экологические эффекты информационных и коммуникационных технологий. Retrived from: <https://rus.kyhistotechs.com/environmental-effects-information-62564050>

1. (2017). Наказ Міністерства аграрної політики та продовольства України, Міністерства екології та природних ресурсів України від 19 червня. № 301/222 (zareєстрований в Міністерстві юстиції України 12 липня).
2. (2017). Наказ за № 842/30710 «Про затвердження Такс для обчислення розміру відшкодування збитків, завданих унаслідок порушення законодавства в галузі мисливського господарства та полювання (крім видів, занесених до Червоної книги України)». Retrived from: <http://zakon0.rada.gov.ua/laws/show/z0842-17>.
3. (2016). Decision of the Ministerial Council of the Energy Community D/2016/14/MC-EnC on amending the Treaty establishing the Energy Community and adapting and implementing Directive 2004/35/EC of the European Parliament and of the Council. *Annex 25a/14, h MC/14-10-2016*. Retrived from: https://www.energy-community.org/dam/jcr:9ff51b44-39e3-42af-ae10-ee1fde1dfdcB/Decision_2016_14_MC_ENV.pdf.
4. (2016). Environment Protection Authority Victoria. Calculating a station air quality index. Retrived from: <http://www.epa.vic.gov.au/your-environment/air/air-pollution/air-quality-index/calculating-a-station-air-quality-index> (дата обращения: 19.08.2016).
5. (2018). "IEEE Standard for Environmental and Social Responsibility Assessment of Computers and Displays. ANSI Blog". The ANSI Blog. 2018-04-06. Retrieved 2020-04-11.
6. (2018). "1680.1-2018 - IEEE Standard for Environmental and Social Responsibility Assessment of Computers and Displays". standards.ieee.org. Retrieved 2020-04-11.
7. Christensen Ken, Reviriego Pedro, Nordman Bruce, Bennett Michael (2010). IEEE 802.3az: The road to energy efficient Ethernet December. IEEE Communications Magazine 48(11): 50–56 DOI: 10.1109/MCOM.2010.5621967
8. (2017). Влияние компьютерной техники на окружающую среду. Retrived from: [http://amti.esrae.ru/pdf/2017/1\(2\)/26.pdf](http://amti.esrae.ru/pdf/2017/1(2)/26.pdf)

Academic integrity

Graduate students are expected to adhere to the Code of Ethics of Academic Relations and Integrity” of NTU “KhPI”.

The content of this syllabus is consistent with the course program.