DECISION MAKING THEORY

COURSE SYLLABUS

Code and name of specialty	121 Software Engineering	**Institute / faculty**	Faculty of Computer Science and Software Engineering
Program name	“Software Engineering”	**Department**	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	**Language of instruction**	Ukrainian, English

LECTURER

Full name, *e-mail* — **GODLEVSKYI Mikhail,** *god_asu@kpi.kharkov.ua*

Doctor of Technical Sciences, Professor, Head of the Department of Software Engineering and Information Technology Management, NTU "KhPI".
Work experience since 1977. Number of scientific and educational publications - 171, including 4 collective monographs, 4 textbooks (Google Scholar https://scholar.google.com.ua/citations?user=_tDsBHEAAAAJ&hl=ru**; ORCID-ID** https://orcid.org/0000-0003-2872-0598**; Scopus ID** https://www.scopus.com/authid/detail.uri?authorId=57202891828 **)**
Leading lecturer in disciplines: «Decision making theory», «Models and methods of decision making support».
Member of the SMC of Ukraine in Computer Science, executive editor of the collection of scientific papers «Bulletin of NTU «KhPI», member of the special council on Information Technology.

Scientific directions: support of decision-making in management tasks of distributed systems development; system optimization; quality of the software development process.

GENERAL DESCRIPTION OF THE COURSE

Summary	Decision making theory is considered as a component of systems analysis and systems theory. The main stages of solving the decision-making problem, which is based on vector optimization, are given. The main methods of solving multicriteria optimization problems are presented. Expert methods of decision evaluation and information technologies of decision support systems are considered.
Course objectives	Mastering the general concepts, methods, models and information technologies of decision support in the implementation of the bachelor's thesis in order to obtain competencies sufficient for practical use in the professional activities of specialists in the specialty "information systems and technologies".
Types of classes and control	Lectures, laboratory classes, consultations. Final control - exam.
Terms	7

Student workload (credits) / Type of course	4 / Mandatory	**Lectures (hours)**	48	**Workshops (hours)**	16	**Self-study (hours)**	56

(Mandatory /elective)							

Programme competencies	GC 01. Ability to abstract thinking, analysis and synthesis. GC 05. Ability to learn and master modern knowledge. GC 06. Ability to search, process and analyze information from various sources PC26. Ability to algorithmic and logical thinking.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
PO01. Analyze, purposefully search for and select the necessary information and reference resources and knowledge to solve professional problems, taking into account modern advances in science and technology.	Interactive lectures with presentations, discussions, practical classes, 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)
PO05. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development.		
PO11. Choose source data for design, guided by formal methods of describing requirements and modelling.		
PO13. Know and apply methods of algorithm development, software design and data and knowledge structures.		
PO18. Know and be able to apply information technology processing, storage and transmission of data.		
PO24. Be able to calculate the economic efficiency of software systems.		

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		**100% Final assessment** as a result of Final exam (40%) та and Continuous assessment (60%). **40% Final exam** **60% Continuous assessment**
	82-89	B	good		
	74-81	C			

	64-73	D	satisfactory		
	60-63	E			
	35-59	FX	Unsatisfactory (with the exam retake option)		
	0-34	F	Unsatisfactory (with mandatory repetition of the course)		

Course policy	Students are required to attend classes according to schedule and adhere to ethical behavior. In the absence of students will need to complete all tasks to compensate for missed classes. Participation in practical classes requires prior preparation and early processing of all necessary materials for productive discussions during the lesson. Written assignments must be submitted by the deadline.

COURSE STRUCTURE AND CONTENT

Theme 1 Lecture 1	Course subject and objectives, object of study, course structure. Examples of the use of decision theory in various spheres of human life. Systemological analysis of decision-making problems	**Laboratory class 1**	Solving a multicriteria problem using Carlin's theorem	**Self-study**	**Topic № 1. Problems of fuzzy mathematical programming.** 1.1. The task of achieving a fuzzy defined goal (Bellman-Zade approach). 1.2. Classification of fuzzy mathematical programming problems. 1.3. Generalization of the fuzzy relationship of preference. The generalization principle. 1.4. The general problem of fuzzy mathematical programming and the method of its solution. 1.5. Transport problem in conditions of uncertainty.
Theme 2 Lecture 2, 3	The problem of decision making as a component of systems analysis and systems theory. Setting and stages of solving decision-making tasks. Difficulties the problem of a unique choice. The problem of evaluation.				
Theme 3 Lecture 4, 5	Classification of methods for evaluation and comparison of multicriteria alternatives. Axiomatic methods. Direct methods. Methods of compensation. Methods of incomparability thresholds. Human-machine decision-making procedures.				
Theme 4 Lecture 6	Measurement and scaling of partial criteria. Scales: names, order, intervals, relations. Absolute scales.	**Laboratory class 2**	Solving a multicriteria problem using the third theorem		
Theme 5 Lecture 7	Vector optimization based on a radical approach. Pareto and Slater sets. Theoretical and practical meaning of effective solutions.				
Theme 6 Lecture 8, 9	Properties of effective alternatives and ways to find them. Basic theorems of vector optimization. The concept of an effective generalized criterion and solution in the problem of multicriteria optimization. The method of constraints in finding compromise solutions in vector optimization problems.	**Laboratory class 3**	Solving a multicriteria problem by the method of constraints		

Theme 7 Lecture 10, 11	Binary relations in decision theory. Operations on binary relations. The concept of the selection function. Functions and mechanisms of choice. Properties of selection mechanisms.				
Theme 8 Lecture 12, 13	Utility theory. Utility types. Rational choice based on the utility function. Conditions for the existence of the utility function. Values identification of utility functions parameters. Conditions of criteria independence. Multicriteria utility theory.	**Laboratory class 4**	Solving a multicriteria problem by the method of successive concessions		**Topic № 2. Multicriteria decision-making problems in conditions of uncertainty.** 2.1. Multicriteria decision-making tasks in terms of certainty. 2.2. Multicriteria linear programming problems with fuzzy objective functions. 2.3. Multicriteria problem of LP with fuzzy parameters in the objective function. 2.4. Multicriteria nonlinear programming with fuzzy parameters.
Theme 9 Lecture 14, 15	Lexicographic optimization problems. Examples of lexicographic problems. Research of lexicographic problem. Representation of a lexicographical relation by one functional. The method of action.				
Theme 10 Lecture 16, 17	Decision support based on system optimization. The method of forming effective solutions. Classification of system optimization problems. System optimization algorithms.				
Theme 11 Lecture 18	Saati pairwise comparison method. Examples of use.	**Laboratory class 5**	Solving a multicriteria problem using the method of sequential introduction of constraints		
Theme 12 Lecture 19, 20	Solve poorly structured problems by analytical hierarchy. Hierarchies of priorities and justification of the method. Algorithm and practical implementations of the method.				
Theme 13 Lecture 21, 22	Methodology of collective expert evaluation. Formation of an expert group. Generation of expert information Examination. Aggregation of expert judgments.				
Theme 14 Lecture 23, 24	Information technologies of decision support systems (DSS). DSS structure. DSS actors. Examples of DSS.				
RECOMMENDED READING					

Compulsory	1. Петров, Е. Г., Новожилова, М. В. , Гребеннік, І. В., Петров, Е. Г. (2004). Методи і засоби прийняття рішень у соціально-економічних системах: навч. посібник. Київ: Техніка. 2. Зайченко, Ю. П. (2014). Теорія прийняття рішень: підручник. Київ: НТУУ «КПІ». 3. Волошин, О. Ф., Мащенко, С. О. (2010). Модель і методи прийняття рішень: навч. посібник. Київ: «Київський університет». 4. Ситник, В. Ф. (2004). Системи підтримки прийняття рішень: навч. посібник. Київ: КНЕУ. 5. Гнатієнко, Г. М., Снитюк, В. Є. (2008). Експертні технології прийняття рішень: монографія. Київ: ТОВ «Маклаут». 6. Катренко, А. В., Пасічник, В. В. (2013). Прийняття рішень: теорія та практика. Львів: «Новий Світ – 2000». 7. Годлевський, М. Д., Воловщиков, В. Ю., Рубін, Е. Ю. (2009). Методичні вказівки для студентів до лабораторних занять з курсу «Теорія прийняття рішень». Харків: НТУ «ХПІ». 8. Бутко, М. П., Бутко, І. М., Мащенко, В. П. (2019). Теорія прийняття рішень: підручник. Київ: Центр навчальної літератури. 9. Негрей, М. В., Тужик, К. Л. (2018). Теорія прийняття рішень: навч. Посібник. Київ: Центр навчальної літератури.	**Recommended**	10. Ларичев, О. И. (1979). Наука и искусство принятия решений. Москва: Наука. 11. Подиновский, В. В., Ногин, В. Д. (1982). Парето-оптимальные решения многокритериальных задач. Москва: «Наука». 12. Фишберн, П. С. (1977). Теория полезности для принятия решений. Москва: Наука. 13. Тоценко, В. Г. (2004). Експертні системи діагностики і підтримки рішень. Київ: «Наукова думка». 14. Крючковский, В. В., Петров, Э. Г., Соколова, Н. А., Ходаков, В. Е. (2011). Интроспективный анализ. Методы и средства экспертного оценивания. Херсон: Гринь Д. С. 15. Михалевич, В. С., Волкович, В. Л. (1993). Концепция построения основных функциональных подсистем системы поддержки принятия решений. Автоматика, 5,3-13. 16. Моисеенко, В. В., Яцкевич, В. В. (1997). Системная оптимизация как обобщение оптимизации классической. Кибернетика и системный анализ, 3, 135–139. 17. Глушков, В. М. (1980). О системной оптимизации. Кибернетика, 5, 89-90. 18. Петровский, А. Б. (2009). Теория принятия решений. Москва: Академия. 19. Згуровский, М. З., Зайченко, Ю. П. (2011). Модели и методы принятии решений в нечетких условиях. Київ: Наукова думка. 20. Саати, Т. (1993). Принятие решения. Метод анализа иерархий. Москва: Радио и связь.

Academic integrity

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to show discipline, politeness, friendliness, honesty, responsibility

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