MATHEMATICAL MODELLING AND SYSTEM ANALYSIS

COURSE SYLLABUS

Code and name of specialty	121 Software Engineering	**Institute**	Faculty of Computer Sciences and Software Engineering
Program name	“Software Engineering”	**Department**	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	**Language of teaching**	

LECTURER

Hamaiun Ihor Petrovich ***Ihor.Hamaiun@khpi.edu.ua***

Doctor of Technical Sciences (05.13.06 - automated management systems and advanced information technologies), Professor of the Department of Software Engineering and Management Information Technologies. Work experience - since 1975. Author (co-author) of more than 120 scientific and educational publications (https://www.scopus.com/authid/detail.uri?authorid=6506853631;https://orcid.org/0000-0003-2099-4658). Main courses: "Fundamentals of Scientific Research" (lectures), "Mathematical Modelling and System Analysis" (lectures, workshops), "Experiment Planning" (lectures, workshops).

GENERAL DESCRIPTION OF THE COURSE

Summary	The course "Mathematical Modelling and System Analysis" is a discipline in the cycle of special mandatory training in the specialty 122 "Computer Sciences". It is taught in the seventh semester in the amount of 120 hours (4 ECTS credits), in particular: lectures - 16 hours, workshops - 16 hours, independent work - 88 hours. There are no individual tasks. The study of the discipline ends with a test.
Course objectives	Formation of students' necessary theoretical knowledge and practical skills of building mathematical models of complex systems, which are necessary to determine the properties of systems, the dynamics of their functioning and forecast their development.
Types of classes and control	Lectures, workshops. Continuous assessment - workshops, intermediary modular assessment. Final assessment - credit.
Term	8

Student workload (credits)/Type of course (mandatory/selective)	4 / Mandatory	**Lectures (hours)**	16	**Workshops (hours)**	16	**Self-study (hours)**	88

Program competences	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)**

PLO 1. 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. PLO 5. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development. PLO11. Choose source data for design, guided by formal methods of describing requirements and modelling. PLO13. Know and apply methods of algorithm development, software design and data and knowledge structures. PLO18. Know and be able to apply information technology processing, storage and transmission of data.	Problem lecture "Modern problems of modelling complex systems". Mini-lecture "Analysis of requirements for models of complex systems". Mini-lecture "Problems of construction and use of simulation models". Case study "Examples of mathematical modelling of real objects". Work in small groups during workshop.	**Continuous assessment CAS:** Assessment of students' work in the process of workshops Intermediary modular control **Final evaluation FAS:** Credit

ASSESSMENT AND GRADING

	core (points) for all types of learning activities	ECTS grading scale	The national grading scale		
Ranges of points corresponding to grades	90-100	A	excellent	**Allocation of grade points**	**100% Final assessment** as a result of Final credit (30%) and Continuous assessment (70%). **30% Final credit**: … **70% Continuous assessment**: … Module №1 (10%) Module №2 (20%) Workshop (40%) Workshop №1 (10%) Workshop №2 (10%) Workshop №3 (10%) Workshop №4 (10%)
	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	The student is required to attend all classes according to the curriculum and adhere to the norms of academic ethics. To study the discipline you need to have your own personal computer and/or use the computers of the computer center of the department. The student must work with required and additional literature, including information resources on the Internet. All workshops must be completed and submitted by the student during the semester in which the discipline is taught, before the examination session. Without the personal presence of the student the final assessment is not carried out.

COURSE STRUCTURE AND CONTENT					
Topic 1	The concept of a mathematical model of a complex system and methods of implementing the process of its construction.	**Workshop 1**	Familiarization with the AnyLogic simulation environment	**Self-study**	Construction of models of complex systems taking into account the hierarchy of their structure. Problems of building aggregate models.
Topic 2	Analytical modelling of the main types of processes in complex systems	**Workshop 2**	Building models of system dynamics in the AnyLogic environment		Models of combination of elements of a complex system.
Topic 3	The essence of simulation and features of its use	**Workshop 3**	Construction of discrete-event models in the AnyLogic environment		The choice of simulation language at the stage of software implementation of the simulation model.
Topic 4	Statistical modelling in analytical and simulation models	**Workshop 4**	Building agent models in the AnyLogic environment.		Methods of processing and analysis of results of experiments with models of systems.

RECOMMENDED READING

Compulsory	1. Sovetov B.Ya. Yakovlev S.A. (1985) Systems modelling M.: Higher school 2. Sergienko I.V. .(1988) (Mathematical models and methods for solving discrete optimization problemsKiev : Naukova Dumka 3. Tomashevsky V. N. Zhdanova O. G. (2003) Simulation in GPSS environment. Moscow: Bestseller 4. Boev V.D., Sipchenko R.P. (2009) Computer simulation. Elements of Theory and Practice: A Textbook. St. Peterburg .: BAC 5. Boev V.D., Kirik D.I., Sipchenko R.P.(2011) Computer Modeling: A Guide to Course and Diploma Design. St.Peterburg: BAC. 6. Hamaiun I.P., Cherednichenko O.Yu. (2015) Modeling of systems: textbook Kharkiv: Fact 7. Hamaiun IP, Kopp A.M., Yangolenko I. V., Liutenko, O.B. (2019) and others. Analysis and modeling of problem-oriented software systems: a textbook / Kharkiv: FOP Chernyak.	**Recommended**	1. Tabunshchik. G.V., Kaplienko T. I., Petrova. O. A. (2016) Design and modeling of software of MODERN information systems Textbook. manual Zaporozhye 2. Petrik M. R. Snail. O.Yu. (2015) Software modeling Scientific-methodical manual Ternopil: TNTU Publishing House. 3. Kiselyova M. V.(2009) Imitation modeling of systems in the environment of AnyLogic: educational and methodical manual Ekaterinburg: UDTU-UPI. 4. Osorgin A. E.(2015) AnyLogic 7. Laboratory workshop Samara: PGK. **INFORMATION RESOURCES ON THE INTERNET** 5. Microsoft Academy: Analysis of requirements for automated information systems: [Electronic resource] Access mode: Retrieved from: http: //www.intuit.ru/studies/courses/2188/174/info 6. Klevtsov S. I. Analysis and formation of requirements for software information systems for data collection and processing. Training manual [Electronic resource] - Access mode: Retrieved from http://rtf.sfedu.ru/!mps/umk/strdsgn_ch1.pdf 7. Design of information systems. Access mode: Retrieved from: https://sites.google.com/site/anisimovkhv/learning/pris/lecture/tema8/tema8_4 8. Grigorev I. AnyLogic for 3 days. Practical manual for simulation modeling Access mode: Retrieved from: http://simulation.su/uploads/files/default/2017-uch-posob-grigoriev-anylogic.pdf, 28.04.18.

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.