Subject code	ECTS credits
MAT4014	6

Course title in Lithuanian

MATEMATINIAI TINKLŲ MODELIAI

Course title in English

MATHEMATICAL NETWORKS MODELS

Short course annotation in Lithuanian (up to 500 characters)

Įgyjamos esminės teorines ir praktines žinias apie tinklines sistemas, tinklinių sistemų grafinį vaizdavimą, grafų ir Markovo modelių teorijos taikymą atliekant tinklinių sistemų modeliavimą. Suformuojami įgūdžiai taikyti tinklų modelius sprendžiant įvairias praktines problemas įvairiose srityse.

Short course annotation in English (up to 500 characters)

Acquired fundamental theoretical and practical knowledge on network system theory, network system modeling and analysis, applying graph theory, Markov models. Acquired skills to apply network models for solving various practical problems in different areas.

Prerequisites for entering the course

Mathematical Analysis, Discrete Mathematics, Probability Theory.

Course aim

Course aim is to provide knowledge of basic concepts of mathematical networks models.

Links between course outcomes, criteria of learning achievement evaluation, study methods and methods of learning achievement assessment

No	Course outcomes	Criteria of learning achievement evaluation	Study methods	Methods of learning achievement assessment
1	Knowledge and understanding of main concepts of networked systems.	Student knows the general notions, theoretical assumptions and results.	Lectures, practical works, individual work, consulting	Mid-term exam, Assessment of practical works
2	Ability to identify suitable mathematical networks model to solve a particular task.	Student demonstrates the ability to identify suitable mathematical networks model to solve a particular task.	Lectures, practical works, individual work, consulting	Final exam, Assessment of practical works
3	Ability to apply Bayesian networks theory to solve a particular task.	Student demonstrates the ability to Bayesian networks to solve a particular task.	Lectures, practical works, individual work, consulting	Final exam, assessment of practical works
4	Ability to apply Markov networks theory to solve a particular task.	Student demonstrates the ability to Markov networks to solve a particular task.	Lectures, practical works, individual work, consulting	Final exam, assessment of practical works
5	Ability to work in a group for a common case study analysis.	Student demonstrates the ability to formulate task, present solution process, justify received results, present research work.	Individual and team work, self-study of literature, discussions, consulting	Assessment of practical work

Links between study programme outcomes and course outcomes

Study programme outcomes	Running number of course outcome			
	1	**2**	**3**	**4**
Comprehend and be able to apply probabilistic and statistical methods for data analysis	+	+	+	+
Summarize and evaluate critically scientific and professional literature, as well as use various tools for collecting of information for the study process and for solving fixed practical/theoretical problems		+	+	+
Identify the problem, collect and analyze real/theoretical data using various mathematical methods, tools and IT technologies		+	+	+
Having good foundations of mathematics, logically and critically recognize and describe relations between quantities of real life and mathematical concepts	+	+	+	+
Think logically and analytically, evaluate alternative ways of task solving and implement optimal solutions		+	+	+
Work individually and/or in groups by developing and adopting appropriate mathematical models and tools for use in case analysis				+
Demonstrate awareness of economic, legal, social, ethical and environmental context in mathematical projects	+	+	+	+

Content

No	Content (topics)
1.	Introduction to networks theory.
2.	Network systems graphical representation.
3.	Applications of graph theory.
4.	Bayesian networks.
5.	Artificial neural networks.
6.	Petri networks.
7.	Transport and energy optimization tasks.
8.	Markov models. Markov chain.
9.	Network models of energy systems and its analysis.

Distribution of workload for students (contact and independent work hours)

Lectures	**45 hours**
Practical work	**30 hours**
Individual students work	**85 hours**
Total:	**160 hours**

Structure of cumulative score and value of its constituent parts

Final written exam (50%), mid-term written exam (25%), assessment of practical work (25%).

Recommended reference materials

No	Publication year	Authors of publication and title	Publishing house	Number of copies in		
				University library	*Self study rooms*	*Other libraries*
Basic materials						
1	2006	Augutis J., Ušpuras E. Technologijų rizika (Technology Risk)	Aušra		40	

2	2008	Pourret O., Naim P., Marcot B. Bayesian Networks. A Practical Guide to Applications.	John Wiley & Sons Ltd.		1	(google books)
3	2007	Graupe D. Principles of Artificial Neural Networks (2nd Edition) Advanced Series on Circuits and Systems – Vol. 6.	World Scientific Publishing Co, Pte. Ltd		1	(google books)
4	2006	Ching W., Ng M.K. Markov Chains: Models, Algorithms and Applications.	Springer Science + Business Media, Inc.		1	(google books)
Supplementary materials						
1	2003	Plukas K., Mačikėnas E., Jarašiūnienė B., Miuckienė I. Taikomoji diskrečioji matematika.	Kaunas, Technologija			
2	2011	Koski T., Noble J.M. Bayesian Networks. An Introduction.	Wiley			

Course programme designed by

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