Z1-PU7	WYDANIE N1	Strona 1 z 3

(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: MODELLING AND DIGITAL SIMULATION	**2. Course code MDS**
3. Validity of course description: 2012/2013	
4. Level of studies: BA	
5. Mode of studies: intramural studies	
6. Field of study: computer science (informatics)	RAU
7. Profile of studies: general academic	
8. Programme: all specialties	
9. Semester: 2	
10. Faculty teaching the course: Institute of Informatics	
11. Course instructor: Prof. dr hab. inż. Tadeusz Czachórski	
12. Course classification: monographic	
13. Course status: elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: knowledge of probability theory and stochastic processes on the level taught at BA courses; rudiments of computer networks and computer systems architectures and principles of their prformance	
16. Course objectives: to achieve skills in the use of mathematical methods used in modelling and performance evaluation of computer systems and computer networks, especially Internet.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Student gets knowledge on operational models, mean value analysis and Markov models of computer systems	test	Lecture, class	
2.	Student acquires knowledge on network models and principles of transmission protocols modeling	test	Lecture, class	
3.	Student knows state of the art and perspectives of several methods used in modeling and performance evaluation of computer networks and is acquainted of the need on constant development of mathematical models and related software	Test, discussion	Lecture, class	
4.	Student is able to use learnt methods in case studies analysis	test	Lecture, class	
5.	Student is able to follow the English literature of the subject and apply new models to study the performances of computer systems and computer networks	discussion	Lecture, class	
6.				
7.				
8.				

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Sem 6: lecture - 30 h, class - 30 h

19. Syllabus description:

Lecture:

Operational models of computer systems: basic laws for the resource utilization, throughput and response time. Definition of a

system bottleneck. Asymptotic and based on balanced systems bounds on a system throughput and response time.
The use of bounds in analysis of the impact of various modifications (exchange of disks, balancing disks, faster processor, virtual memory) on the performance of a computer system.
Queueing networks as a model of a system - the use of mean value analysis (MVA), models of the open and closed network, introduction of multiple classes of customers, the use of approximate MVA algorithm. MVA algorithm in analysis of TCP congestion avoidance mechanism and the transport time evaluation. Optimization of a "connection power" parameter.
Investigation of TCP connection stability with the use of control theory approach.
Simple probabilistic models and their justification. Single server models based on Markov chains, introduction of limited queue and loss probability, parallel service channels, limited set of customers; examples of a router and a local network models.
Queueing Markov models of an open and closed network, related computational algorithms. Models of traffic intensity based on Markov chains and hidden Markov chains. Markov models solved numerically and their application in the analysis of congestion avoidance (threshold, leaky-bucket, sliding window, jumping window, push-out queue) algorithms.
Models of all optical networks routing, a model of electrical-optical edge router.
Diffusion and fluid flow approximations in the analysis of transient states, application to the analysis of packet queues in IP routers, models of active queue management (e.g. random early deletion) in IP routers. Statistical properties of internet traffic (self-similarity, long term autocorrelation) and their influence on network performance.
Classes: 1. Computational operational models of a computer system. 2. Bounds on a system response time and throughput. 3. Mean value analysis, open networks. 4. Mean value analysis, closed networks. 5. Mean value analysis, multiple classes of customers. 6. Markov models, single service station. 7. Markov models, open networks. 8. Markov models, closed networks. 9. Transient analysis - Markov models and fluid flow approximation . 10. Transient analysis - diffusion approximation. 11. Telecommunication traffic models.

20. Examination: no examination

21. Primary sources:

1. T. Czachórski, "Modele kolejkowe w ocenie efektywności sieci i systemów komputerowych", Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, Gliwice 1999.

22. Secondary sources:

1. M. Hassan and R. Jain, "High Performance TCP/IP Networking: Concepts, Issues, and Solutions", Prentice-Hall, 2003, ISBN:0130646342, ISBN:0131272578

2. R. Jain, The Art of Computer Systems Performance Analysis, Wiley Interscience 1991

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/30
2	Classes	30/30
3	Laboratory	/
4	Project	/
5	BA/ MA Seminar	/
6	Other	/
	Total number of hours	/

24. Total hours: 60

25. Number of ECTS credits:

26. Number of ECTS credits allocated for contact hours:

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*