(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: PERFORMANCE EVALUATION OF COMPUTER NETWORKS	**2. Course code** PECN
3. Validity of course description: 2015/2016	
4. Level of studies: MSc	
5. Mode of studies: intramural studies	
6. Field of study: informatics	RAU
7. Profile of studies: general academic	
8. Programme: -	
9. Semester: 2	
10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science	
11. Course instructor: Prof. dr hab. inż. Tadeusz Czachórski	
12. Course classification: common	
13. Course status: compulsory	
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 architectures and principles of their performance, especially of the performance of communication protocols (TCP/IP)	
16. Course objectives: to achieve skills in the use of mathematical methods used in modelling and performance evaluation of computer networks.	

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, Markov chain models, diffusion approximations queueing models of computer networks	test	Lecture	K_W04
2.	Student gets knowledge on mean value analysis applied to model computer networks.	test	Lecture	K_W01
3.	Student is able to apply analytical models, e.g. Markov chain models, in the performance analysis of computer networks.	test	Lecture, Laboratory	K_U10
4.	Student is able to apply the acquired knowledge of simulation models to evaluate performances of computer networks. Student is able to evaluate simulation errors.	test	Laboratory	K_U09
5.	Student is able to apply the acquired knowledge to study the performances of a proposed topology of a computer networks.	test	Laboratory	K_U08

18. Teaching modes and hours

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

Sem 8: lecture - 15 h, laboratory - 15 h

19. Syllabus description:

Lecture:

Operational models of computer networks: basic laws for the resource utilization, throughput and response time. Definition of a network bottleneck. Queueing networks as a model of a communication network - 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 queueing 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.

Laboratory: Simple simulation queueing models and models of computer networks written with the use of OMNET++ system.

20. Examination: no examination

21. Primary sources:

1. T. Czachórski, "Modele kolejkowe w ocenie efekty wności sieci i systemów komputerowych", Wydawnictwo Pra cowni 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	15/15
2	Classes	
3	Laboratory	15/15
4	Project	/
5	BA/ MA Seminar	/
6	Other	/
	Total number of hours	/

24. Total hours: 30

25. Number of ECTS credits: 2

26. Number of ECTS credits allocated for contact hours: 1

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

Approved:

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(date, Instructor's signature)

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