

<b>Study program:</b> Communication technologies			
<b>Course title:</b> Undergraduate vocational studies			
<b>Professor/assistant:</b> Quality of Service in Communication Systems			
<b>Type of course:</b> elective			
<b>ECTS credits:</b> 6			
<b>Pre-requisites:</b> none			
<b>Aims of the course:</b> Introducing students to: 1) QoS parameters for various digital telecommunication systems 2) relation between QoS parameters and network performance 3) algorithms used to guarantee quality of service 4) network optimization.			
<b>Learning outcomes:</b> After this course, it is expected that students are able to apply the obtained knowledge in estimation of service and network performances.			
<b>Syllabus</b> <i>Theoretical part</i> Classification of communication systems. Effects that degrade performances of communication systems. Quality of service (QoS) term. Indicators for describing QoS. Objective and subjective (QoE) parameters. Required values of QoS for multimedia services. Monte Carlo simulation for estimation of probability of error. Error detection and correction. ECC in modern systems. QoS algorithms in IP networks - best-effort, IntServ, DiffServ. DiffServ techniques - classification and traffic marking, restriction and alignment, congestion control, avoiding congestion, specific techniques on link (fragmentation, interleaving, compression). Optimization - the shortest path, max-flow, min-cost flow.  <i>Practical part</i> Estimation of error probability, outage probability, transmission rate, delay, packet loss probability, redundancy, spectral efficiency. Network optimization techniques.			
<b>Literature</b> 1. T. Saadawi, M. Ammar, A. El Hakeem, <i>Fundamentals of telecommunication networks</i> , John Wiley & Sons, NY, 1994. 2. D. P. Bertsekas, <i>Network optimization: continuous and discrete models</i> , Athena scientific, Massachusetts, 1998. 3. Z. Urošević, <i>Uvod u računarske telekomunikacije i mreže – transportni deo</i> , Tehnički fakultet u Čačku, 2004. 4. D. Drajić, P. Ivaniš, <i>Uvod u teoriju informacija i kodovanje</i> , Akademska misao, Beograd, 2009.			
<b>Number of active classes</b> 60			Other forms of teaching:
Lectures: 30	Practical classes: 30	Research work:	
<b>Teaching methods</b> Lectures, computational exercises, homework, consultations.			
<b>Grading system</b> (maximum 100 points), <b>grading scale</b> from 5 to 10: below 51 points grade 5, grade 6 from 51-60 points, grade 7 from 61-70 points, grade 8 from 71-80 points, grade 9 from 81-90 points, grade 10 from 91-100 points.			
<b>Pre-exam obligations</b>	<b>points</b>	<b>Final exam</b>	<b>points</b>
activity during theoretical lectures	10	written exam	20
practical training	40	oral exam	10
colloquium(s)/seminar papers	20		
<b>Sum</b>	<b>70</b>	<b>Sum</b>	<b>30</b>