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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Telekomunikacijski protokoli | | | | | | | | | | | | | | |
| **Course title:** | | | Telecommunication Protocols | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | Informacijsko komunikacijske tehnologije | | | | | | | | 3. | | letni | | |
| 1st cycle academic study programme Electrical Engineering | | | | | Information and communications technologies | | | | | | | | 3. | | summer | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni – strokovni / compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64176 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** |  | | | **30** | | |  | | | |  | | | **75** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | Grega Jakus | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **slovenski** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **slovenski + English (če so prisotni tuji študenti / if foreign students are present)** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the year of the course. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Storitev (uporabnik in izvajalec storitve, specifikacija storitve, točka dostopa do storitve, primitivi). Protokol (protokol kot implementacija storitve, protokolni osebki, protokol kot jezik, specifikacija protokola). Sporočila (SDU, PDU, uporabniško sporočilo in režija, zgradba PDU). Protokolni sklad (principi, model OSI, sklad TCP/IP, SS7, ATM, komunikacijske ravnine, tuneliranje). Specifikacija komunikacijskih sistemov in protokolov (specifikacija strukture TK sistema, specifikacija protokolnih sporočil in pravil, abstraktna in konkretna sintaksa, (razširjeni) končni avtomat, SDL, MSC). Učinkovitost protokola in protokolnega sklada. Osnovne naloge protokolov. Oblikovanje in razpoznavanje protokolnih sporočil (razpoznavanje pri sinhronem in asinhronem prenosu, transparentni prenos). Upravljanje zvez (dvojni dogovor, trojni dogovor, reševanje kolizij, pogajanja). Protokoli za zagotavljanje zanesljivega prenosa (odkrivanje in popravljanje napak, protokoli z drsečim oknom). Krmiljenje pretoka in zamašitev (potreba po krmiljenju, krmiljenje pretoka, krmiljenje zamašitev, metode krmiljenja). Drobljenje in ponovno sestavljanje. Protokoli za dostop do skupnega medija. Zgledi protokolov (podrobnejša obravnava protokolov TCP, UDP, IP, ICMP, Aloha, CSMA/CD, ARP in nekaterih aplikacijskih protokolov v Internetu). Protokolna analiza. | | | | | | | |  | | Telecommunication service (user, provider, service specification, service access point, primitives). Protocol (protocol as service implementation, protocol entities, protocol as a language, protocol specification). Messages (SDU, PDU, user message and overhead, PDU structure). Protocol stack (principles, OSI model, TCP/IP, SS7, ATM, communication planes, tunneling). Communication system and protocol specification (telecommunication system structure specification, PDU and protocol rules specification, abstract and transfer syntax, (extended) finite state machine, SDL, MSC). Protocol and protocol stack efficiency. Important functionalities of protocols. PDU formatting and synchronisation (synchronous and asynchronous transfer, transparent transfer). Connection management (two-way handshake, three-way handshake, collision resolution, negotiations). Providing reliable transfer (error detection and correction, sliding window protocols). Flow and congestion control (the need for control, flow control, congestion control, control methods). Segmentation and reassembly. Medium access control protocols. Examples of some specific protocols (a more detailed description of protocols TCP, UDP, IP, ICMP; Aloha, CSMA/CD, ARP, and some Internet-related application-layer protocols). Protocol analysis. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Hercog, D., *Telekomunikacijska omrežja*, Pasadena, 2013 (in Slovenian) 2. Hercog, D., *Telekomunikacijski protokoli*, učbenik v pripravi (in Slovenian) 3. Stallings, W., *Data and Computer Communications*, *9th Ed*., Pearson Prentice-Hall, 2011 4. Sharp, R., *Principles of Protocol Design*, Springer, 2008   5. Jakus, G., Tomažič, S., *Long term evolution (LTE) of mobile radio communications*. V: Furht, B (ur.). *Encyclopedia of wireless and mobile communications*. Boca Raton; New York: Taylor & Francis, cop. 2008. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Razumevanje principov in metod prenosa sporočil skozi telekomunikacijski sistem, pomen telekomunikacijskih storitev in protokolov ter protokolnih skladov. Poznavanje tehnik za specifikacijo protokolov. Poznavanje in načrtovanje protokolov za zagotavljanje zanesljivega prenosa sporočil. Pregled nekaterih najpomembnejših protokolov. | |  | | Understanding principles and methods for message transfer through telecommunication system, purpose of telecommunication services, protocols and protocol stacks. Expertise in protocol specification techniques. Understanding and design of protocols to assure reliable message transfer. Overview of some most important telecommunication protocols. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Poudarek predmeta je na razumevanju principov, poznavanje konkretnih metod in protokolov je namenjeno predvsem poglabljanju in utrjevanju razumevanja principov ter integraciji posamičnih znanj. | | |  | The course emphasis is on understanding principles, the goal of studying specific methods and protocols is to deepen and strengthen the principles understanding, as well as knowledge integration. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja in laboratorijske vaje. Pri predavanjih študenti spoznavajo principe in jih utrjujejo na podlagi številnih zgledov, pri vajah pa spoznavajo praktične vidike protokolov s pomočjo specifikacij protokolov, simulacij učinkovitosti protokolov, poskusov z nekaterimi protokoli aplikacijskega sloja v protokolnem skladu TCP/IP ter protokolno analizo s programom Wireshark. Samostojno morajo izdelati seminarsko nalogo (implementacija aplikacijskega protokola v poljubnem programskem jeziku in njegova specifikacija v jeziku SDL oziroma v drugih primerljivih formalnih jezikih); nalogo morajo zagovarjati, kar je pogoj za pristop k izpitu. Izpit je pisni in ustni. Del ustnega izpita je tudi pregled in komentar pisnega dela izpita ter zagovor poročila o opravljenih vajah. | | |  | Lectures and laboratory work. In lectures, principles are explained and illustrated with numerous examples. In laboratory, practical aspects of protocols are studied based on protocol specification, protocol efficiency simulation, experiments with some application-layer protocols of the TCP/IP stack, and protocol analysis with Wireshark software. Students must work on their own on a homework assignment (implementation of an application protocol in an arbitrary programming language, and its specification using SDL or other comparable formal languages); the assignment must be explained before the exam. The exam consists of written and oral exam. Examination and discussion of the written exam as well as discussion on laboratory work are parts of oral exam. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Opravljene laboratorijske vaje so pogoj za pristop k izpitu.  Prispevki k oceni:  Pisni izpit  Ustni izpit | **50 %**  **50 %** | | | | Type: laboratory exercises, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Completed laboratory exercises are a prerequisite for the exam.  Contributions to final grade:  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| **1.** JAKUS, Grega, MILUTINOVIĆ, Veljko, OMEROVIĆ, Sanida, TOMAŽIČ, Sašo*. Concepts, ontologies, and knowledge representation*, (SpringerBriefs in computer science (Print)). New York [etc.]: Springer, cop. 2013. **2.** JAKUS, Grega, TOMAŽIČ, Sašo. Long term evolution (LTE) of mobile radio communications. V: FURHT, Borivoje (ur.). *Encyclopedia of wireless and mobile communications*. Boca Raton; New York: Taylor & Francis, cop. 2008, str. 1-10.  **3.** JAKUS, Grega, SODNIK, Jaka, TOMAŽIČ, Sašo. The architectural design of a system for interpreting multilingual web documents in E-speranto. *Journal for universal computer science*, ISSN 0948-6968, 2011, vol. 17, no. 3, str. 377-398.  **4.** JAKUS, Grega, JEKOVEC, Matija, TOMAŽIČ, Sašo, SODNIK, Jaka. New technologies for web development. *Elektrotehniški vestnik*, ISSN 0013-5852. [Slovenska tiskana izd.], 2010, letn. 77, št. 5, str. 273-280.  **5.** STANČIN, Sara, JAKUS, Grega, TOMAŽIČ, Sašo. Transcoding free voice transmission in GSM and UMTS networks. V: 1st International Conference on Information Society Technology and Management, Kopaonik, 07. 03. - 08. 03. 2011. KONJOVIĆ, Zora (ur.). *ICIST 2011*. Belgrade: Association for Information Systems and Computer Networks, 2011, str. 1-6. | | | | | |