|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Modul G: Mobilnost in internet stvari | | | | | | | | | | | | | | |
| **Course title:** | | | Module G: Mobility and Internet of things | | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | |  | |  | | |
| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Vse smeri | | | | | | | | 1 | | 2 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | All study fields | | | | | | | | 1 | | 2 | | |
|  | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni-strokovni / elective professional | | | | | |
|  | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64271S | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 45 |  | | | 30 | | |  | | | |  | | | 75 | |  | 6 |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Janez Bešter, Urban Sedlar | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian  angleški / English | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian  angleški / English | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik predmeta | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Značilnosti mobilnih sistemov (razpoložljiv radijski spekter, pokrivanje s celicami, kapaciteta radijskega kanala, upravljanje mobilnosti).  Komercialna mobilna omrežja 2G, 3G in 4G (arhitekture omrežij, posebnosti sodostopa, razvoj jedra, vzpostavljanje povezav, zagotavljanje varnosti).  Potrebe interneta stvari po povezljivosti (razvoj mobilnih omrežij v smeri IoT, posebnosti komunikacije IoT, omrežja LTE-M, SigFox, LoRa primeri).  Komunikacijska omrežja za kritično infrastrukturo (namenska omrežja nacionalnega pomena brez prekinitev).  Lokalna brezžična omrežja WLAN (različice 802.11b/g/n/ac/ad, načrtovanje in upravljanje omrežij, zagotavljanje QoS in varnosti).  Brezžična senzorska omrežja na kratke razdalje (Bluetooth, ZigBee, RFID, NFC in druga).  Storitvena področja interneta stvari (pametna mesta, inteligentne stavbe, lokacijske storitve, cestna telematika, zdravstvo, energetika). | | | | | | | |  | | Characteristics of mobile systems (available radio spectrum, cellular coverage, radio channel capacity, mobility management).  Commercial mobile networks 2G, 3G and 4G (network architectures, multiple access, core evolution, connection establishment, security).  Internet of things connectivity issues (evolution of mobile technologies towards IoT, IoT communication requirements, LTE-M, SigFox, LoRa examples).  Critical communications infrastructure (special networks of national importance with high availability).  Wireless local area networks WiFi (overview of 802.11b/g/n/ac/ad, planning and management, QoS and security).  Short range wireless sensor networks (Bluetooth, ZigBee, RFID, NFC, proprietary).  Internet of things applications and services (smart cities, intelligent buildings, location services, road telematics, health services, smart grids). | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Temeljni literatura in viri / Readings:** | | | | | | |
| 1. Sauter, M., From GSM to LTE-Advanced: An Introduction to Mobile Networks and Mobile Broadband, John Wiley & Sons, Chichester, 2014 2. Chilamkurti, N., Next-Generation Wireless Technologies: 4G and Beyond, Springer-Verlag London, 2013 3. Gratton, D. A., The Handbook of Personal Area Networking Technologies and Protocols, Cambridge University Press, New York, 2013 4. Balani, N., Enterprise IoT: A Definitive Handbook, CreateSpace Independent Publishing Platform, 2015 5. Članki, objavljenih v revijah, npr. / Articles published in magazines, i.e.: IEEE Communications Surveys & Tutorials, <http://www.comsoc.org/livepubs/surveys/index.html> | | | | | | |
| **Cilji in kompetence:** | | |  | | **Objectives and competences:** | |
| Izbirni predmet podaja sistematičen pregled mobilnih tehnologij ter pripadajočih storitev s področja interneta stvari s poudarkom na razumevanju značilnosti, temeljih delovanja ter razvojnih možnostih. Primeren je za zainteresirane študente vseh smeri. | | |  | | The elective course provides a systematic overview of mobile technologies and their role in the Internet of things scenarios with emphasis on understanding of characteristics, operation principles and development activities. The course is suitable for all interested students not regarding study field. | |
| **Predvideni študijski rezultati:** | | | |  | **Intended learning outcomes:** | |
| Razumevanje delovanja mobilnih, lokalnih in osebnih brezžičnih omrežij ter njihova uporaba na storitvenih področjih interneta stvari. | | | |  | Understanding of mobile, local-area and personal wireless networks performances, and their applications in the Internet of things. | |
|  | | | |  |  | |
| **Metode poučevanja in učenja:** | | | |  | **Learning and teaching methods:** | |
| Predavanja, na katerih se študent seznani s teoretičnimi osnovami, ter laboratorijske vaje, kjer probleme spozna tudi praktično in jih v timu rešuje skozi projektno delo. E-izobraževanje. Ogledi in vabljeni predavatelji. | | | |  | Lectures for the provisioning of theoretical aspects and laboratory practices with real-case scenarios and solving the problems through team project work. ELearning. Study visits and invited lecturers. | |
| **Načini ocenjevanja:** | | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Uspešna izvedba 80% laboratorijskih vaj je predpogoj za prijavo na pisni izpit.  Prispevki k oceni:  pisni izpit  ustni izpit | | 50%  50% | | | | Type: written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Successful completion of at least 80% of the laboratory exercises is prerequisite for the written exam.  Contributions to final grade:  written exam  oral examination |
|  |  | | | | |  |
| **Reference nosilca / Lecturer's references:** | | | | | | |
| 1. KOS, Andrej, SEDLAR, Urban, STERLE, Janez, VOLK, Mojca, BEŠTER, Janez, BAJEC, Marko. Network monitoring applications based on IoT system. V: Proceedings of the 2013 18th European Conference on Network and Optical Communications & 2013 8th Conference on Optical Cabling and Infrastructure (NOC-OC&I). Graz: University of Technology, Institute of Microwave and Photonic Engineering, 2013, str. 69-73 2. KOS, Andrej, SEDLAR, Urban, KORŠIČ, Luka, VOLK, Mojca, BEŠTER, Janez. Taktična komunikacijska omrežja prihodnosti. V: Trideseta delavnica o telekomunikacijah, 12. in 13. maj 2014, Brdo pri Kranju, Slovenija. SIMIČ, Nikolaj (ur.). Omrežja prihodnosti : zbornik referatov, (VITEL, ISSN 1581-6737). Ljubljana: Elektrotehniška zveza Slovenije, 2014, f. 22-26, ilustr. 3. VODOPIVEC, Samo, BEŠTER, Janez, KOS, Andrej. A multihoming clustering algorithm for vehicular ad hoc networks. International journal of distributed sensor networks, ISSN 1550-1477. [Online ed.], 2014, vol. 2014, str. 1-8. 4. UMBERGER, Mark, HUMAR, Iztok, KOS, Andrej, GUNA, Jože, ŽEMVA, Andrej, BEŠTER, Janez. The integration of home-automation and IPTV system and services. Computer standards & interfaces, ISSN 0920-5489. [Print ed.], Jun. 2009, vol. 31, no. 4, str. 675-684. 5. KOS, Andrej, SEDLAR, Urban, STERLE, Janez, VOLK, Mojca, BEŠTER, Janez, BAJEC, Marko. Network monitoring applications based on IoT system. V: Proceedings of the 2013 18th European Conference on Network and Optical Communications & 2013 8th Conference on Optical Cabling and Infrastructure (NOC-OC&I). Graz: University of Technology, Institute of Microwave and Photonic Engineering, 2013, str. 69-73. | | | | | | |