UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Upravljanje virov v brezžičnih omrežjih
Course title:	Resource Management for Wireless Networks

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 2. stopnja	Komunikacijske tehnologije	1	2
Information and Communication Technologies, 2nd cycle	Communication Technologies	1	2

Vrsta predmeta / Course type　　　　　　　Izbirni / Elective

Univerzitetna koda predmeta / University course code:　　　IKT2-639

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
15	15			15	105	5

*Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.

Nosilec predmeta / Lecturer:　　　Prof. dr. Mihael Mohorčič

Jeziki / Languages:	Predavanja / Lectures: Vaje / Tutorial:	slovenščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zaključen študijski program prve stopnje s področja naravoslovja, tehnike ali računalništva.	Student must complete first-cycle study programmes in natural sciences, technical disciplines or computer science.

Vsebina:

Uvod:
    definicija problema upravljanja z radijskimi viri, osnovni pojmi in terminologija pri upravljanju virov
Brezžične dostopovne tehnologije:
    FDMA, TDMA, CDMA, OFDM, OFDMA
Interferenca in upravljanje z viri:
    SINR
Upravljanje z mobilnostjo in predaje zvez:
    vrste predaj zvez, postopek predaje zveze, upravljanje z viri pri predaji zveze
Strategije dodeljevanja kanalov:
    statično dodeljevanje kanalov, dinamično dodeljevanje kanalov, hibridno dodeljevanje kanalov, dinamičen dostop do frekvenčnega

Content (Syllabus outline):

Introduction:
    definition of radio resource management problem, basic principles and terminology of resource management
Wireless Access Technologies:
    FDMA, TDMA, CDMA, OFDM, OFDMA
Interference and radio resource management:
    SINR
Mobility Management and Handovers
    handover types, handover procedure, handover resource management
Channel Allocation Strategies:
    fixed channel allocation, dynamic channel allocation, hybrid channel allocation, dynamic spectrum access - cognitive radio

spektra - kognitivni radio	Data Rate and Transmit Power Control:
Krmiljenje prenosne hitrosti in oddajne moči: iskanje optimalnega razmerja med prenosno hitrostjo, kapaciteto omrežja, velikostjo pokritja, porabo energije in interference	optimisation and balancing between data rate, network capacity, coverage area, power consumption and interference
Krmiljenje dostopa	Admission Control
Razporejanje paketov	Packet Scheduling
Izzivi za upravljanje virov v brezžičnih omrežjih prihodnje generacije	Future Trends in Radio Resource Management in Next Generation Networks

Temeljna literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- J. Zander, S.-L. Kim, *Radio Resource Management for Wireless Networks*, Artech House, 2001. ISBN 978-1-5805-3146-7
- Y. Zhang, H. Hu, M. Fujise, Eds. *Resource, Mobility, and Security Management in Wireless Networks and Mobile Communications*, Auerbach Publications, 2006. ISBN 978-0-8483-8036-5
- M. Cardei, I. Cardei, D.-.Z. Du, Eds. *Resource Management in Wireless Networking*, Springer, 2005, ISBN 978-0-387-23808-1
- V. Hasu, *Radio Resource Management in Wireless Communication: Beamforming, Transmission Power Control, and Rate Allocation*, Helsinki University of Technology, 2007, ISBN 978-951-22- 8821-2
- E. Björnson, E. Jorswieck, *Optimal Resource Allocation in Coordinated Multi-Cell Systems,* Foundations and Trends in Communications and Information Theory, vol. 9, no. 2-3, pp. 113-381, 2013

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študenta z znanji s področja upravljanja virov v brezžičnih omrežjih. Kompetence študenta bodo po uspešno opravljenem predmetu obsegale sposobnost analize, sinteze in predvidevanja rešitev ter posledic ter obvladanje raziskovalnih metod, postopkov in procesov in razvoj kritične ter samokritične presoje.	The aim of the course is to familiarize the student with the knowledge in the field of resource management for wireless networks. The competencies of the students completing this course successfully will include the ability to analyse, synthesize and anticipate solutions and consequences, to gain the mastery over research methods, procedures and processes and a development of the critical judgment.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili: - poznavanje problematike upravljanja virov in njegovega pomena za zagotavljanje kakovosti storitev v brezžičnih omrežjih, - razumevanje osnovnih mehanizmov upravljanja radijskih virov, - poznavanje smeri razvoja mehanizmov upravljanja virov v brezžičnih omrežjih naslednje generacije.	Students successfully completing this course will acquire: - knowledge of the problem of resource management and its importance for the provision of quality of service for wireless networks - understanding of basic radio resource mechanisms - knowledge of future trends in resource management mechanisms for wireless networks

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar, konzultacije, individualno delo	Lectures, seminar, consultancy, individual work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga	50 %	Seminar work
Ustni zagovor seminarske naloge	50 %	Oral defense of seminar work

Reference nosilca / Lecturer's references:

- C. Fortuna, A. Bekan, T. Javornik, G. Cerar, **M. Mohorcic**, "Software interfaces for control, optimization and update of 5G machine type communication networks", Computer networks : the international journal of computer and telecommunications networking, ISSN 1389-1286. [Print ed.], 2017, vol. 129, part 2, pp. 373-383, doi: 10.1016/j.comnet.2017.06.015.
- M. Sociu, T. Solc, L. Cremene, **M. Mohorcic**, C. Fortuna, "Discrete transmit power devices in dense wireless networks : methodology and case study", IEEE access, ISSN 2169-3536, 2017, vol. 5, pp. 1762-1778, doi: 10.1109/ACCESS.2017.2669403.
- C. Fortuna, **M. Mohorčič,** "A framework for dynamic composition of communication services", *ACM transactions on sensor networks,* vol. 11, no. 2, pp. 31-1-31.10, 2015.
- T. Šolc, C. Fortuna, **M. Mohorčič**, "Low-cost testbed development and its applications in cognitive radio prototyping", V: M.-G. di Benedetto, edt. *Cognitive radio and networking for heterogeneous wireless networks: recent advances in visions for the future*, Springer, 2015, pp. 361-405.
- M. Pesko, T. Javornik, L. Vidmar, A. Košir, M. Štular, **M. Mohorčič**, "The indirect self-tuning method for constructing radio environment map using omnidirectional or directional transmitter antenna", *EURASIP Journal on wireless communications and networking*, 2015, 12 pp., doi: 10.1186/s13638-015-0297-2.