

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Brezžične komunikacije
Course title:	Wireless Communications

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, 2 nd cycle	Communication Technologies	1	2

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT2-638

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
30	30			30	210	10

**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 transferred to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Gorazd Kandus

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Zaključen študijski program prve stopnje s področja naravoslovja, tehnike ali računalništva.

Prerequisites:

Student must complete first-cycle study programmes in natural sciences, technical disciplines or computer science.

Vsebina:

Uvod:
 zgodovina brezžičnih komunikacij, pregled fiksnih in mobilnih brezžičnih sistemov, spekter, brezžične storitve in aplikacije
 Brezžični kanal:
 mehanizmi razširjanja, ozkopolasovni in širokopolasovni modeli kanala, kapaciteta, interferenca, presih, močnostna in spektralna učinkovitost
 Oddajnik-sprejemnik in obdelava signala:
 modulacijski in kodni postopki, raznolikost, združevanje in izenačevanje, optimalni sprejem signala
 Omrežni vidiki:

Content (Syllabus outline):

Introduction:
 history of wireless communication, overview of fixed and mobile wireless systems, spectrum, wireless services and applications
 Wireless Channel:
 propagation mechanisms, narrowband and wideband channel models, capacity, interference, fading, power and spectral efficiency
 Transceiver and Signal Processing:
 modulation and coding techniques, diversity, combining and equalization, optimal signal reception
 Network Aspects:

<p>načrtovanje radijskega omrežja, pokritost z radijskim signalom, upravljanje mobilnosti, kakovost storitve</p> <p>Programirljivi radio: referenčni modeli in arhitekture sistema, rekonfigurabilnost, upravljanje omrežja</p> <p>Nove tehnologije radijskega vmesnika: sodostop in celična načela, OFDM, sistemi z razpršenim spektrom, sistemi z več vhodi in več izhodi, pametne antene</p> <p>Brezžični komunikacijski sistemi: celični sistemi, LEO, MEO, GEO satelitski sistemi, visoko leteče platforme</p> <p>Mobilni sistemi druge in tretje generacije: GSM, GPRS, CDMA, DECT, TETRA, UMTS, IMT-2000 tehnologije, brezžične 3G IP omrežne arhitekture, protokoli in storitve</p> <p>Mobilni sistemi četrte in pete generacije: HSPA, LTE, WiMAX, 5G tehnologije in infrastruktura</p> <p>Brezžična širokopasovna omrežja: pregled omrežij, standardov, tehnologij, načrtovanje, aplikacije in storitve</p> <p>Priložnostna brezžična omrežja: načela načrtovanja in aplikacije, protokolni sloji, energetska omejena omrežja</p> <p>Varnost v brezžičnih omrežjih: pooblastitev, prepoznavanje, overjanje, kriptografski algoritmi</p>	<p>radio network planning, radio signal coverage, mobility management, quality of service</p> <p>Software Defined Radio: reference models and system architectures, reconfigurability and network management</p> <p>New Air Interface Technologies: multiple access and cellular principles, OFDM, spread spectrum systems, multiple input multiple output systems, smart antennas</p> <p>Wireless Communication Systems: cellular systems, LEO, MEO, GEO satellite systems, High Altitude Platforms,</p> <p>Second and Third Generation Mobile Systems: GSM, GPRS CDMA,, DECT, TETRA, UMTS, IMT-2000 technologies, wireless 3G IP network architectures, protocols and services</p> <p>Fourth and Fifth Generation Systems:HSPA, LTE, WiMAX, 5G technologies and infrastructure</p> <p>Wireless Broadband Networks: overview of networks, standards, technologies, planning, applications and services</p> <p>Ad Hoc Wireless Networks: design principles and applications, protocol layers, energy constrained networks</p> <p>Security in Wireless Networks: authorization, identification, authentication, cryptographic algorithms</p>
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Temeljna literatura in viri / Readings:

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

- A. F. Molisch, *Wireless Communications*, Wiley, 2010. ISBN: 978-0-470-74186-3
- M. Sauter, *3G, 4G and Beyond; Bringing Networks, Devices and the Web Together*, Wiley, 2013. ISBN: 978-1-118-34148-3
- G. L. Stüber, *Principles of Mobile Communications*, Springer, 2012. ISBN: 978-1-4614-0364-7
- A. Goldsmith, *Wireless Communications*, Cambridge University Press, 2012. ISBN: 978-0-511-84122-4
- J. Ramiro, K. Hamied, *Self-Organizing Networks*, Wiley, 2012. ISBN: 978-0-470-97352-3

Cilji in kompetence:

Cilj predmeta je seznaniti študenta z znanji s področja brezžičnih komunikacij.

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.

Objectives and competences:

The aim of the course is to familiarize the student with the knowledge in the field of wireless communications.

The competencies of the students completing this course successfully will include the ability to analyze, 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:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili:

- razumevanje pojavov v radijskem kanalu in postopkov digitalne obdelave signala v sprejemnih in oddajnih napravah
- poznavanje standardov in drugih priporočil, ki so osnova za načrtovanje brezžičnih sistemov
- poznavanje sodobnih postopkov in tehnologij, ki omogočajo varen, zanesljiv in učinkovit radijski prenos govora in podatkov
- poznavanje postopkov za načrtovanje brezžičnih omrežij in metod izračuna pokritja z radijskim signalom

Intended learning outcomes:

Students successfully completing this course will acquire:

- understanding of phenomena in radio channel and digital signal processing techniques in transceivers
- knowledge of standards and other recommendations needed for wireless systems design
- knowledge of advanced techniques and technologies, enabling secure, reliable, and efficient radio transmission of voice and data
- knowledge of techniques for wireless network design and methods for calculation of radio signal coverage

Metode poučevanja in učenja:

Predavanja, seminar, konzultacije, individualno delo

Learning and teaching methods:

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:

- A. Hrovat, **G. Kandus**, T. Javornik, "A survey of radio propagation modeling for tunnels," *IEEE Communications surveys and tutorials*, vol. 16, no. 2, pp. 658-669, 2014.
- R. Libnik, A. Švigelj, **G. Kandus**, "A novel SIP based procedure for congestion aware handover in heterogeneous networks," *Computer communications*, vol. 33, no. 18, pp. 2176-2184, 2010.
- F. Nadeem, E. Leitgeb, **G. Kandus**, T. Javornik, "Comparing the cloud effects on hybrid network using optical wireless and GHz links," *IET communications*, vol. 6, no. 5, pp. 492-498, 2012.
- I. Androulidakis, **G. Kandus**, "Mobile phone security - awareness and practices," *The Journal of the Institute of Telecommunications Professionals*, vol. 7, no. 1, pp. 16-22, 2013.
- A. Švigelj, M. Mohorčič, L. Franck, **G. Kandus**, "Signalling analysis for traffic class dependent routing in packet switched ISL networks," *Space communications*, vol. 22, no. 2/4, pp. 191-203, 2013.