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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Modul K: Satelitske komunikacije in navigacija | | | | | | | | | | | | | | |
| **Course title:** | | | Module K: Satellite Communication and Navigation | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Informacijsko komunikacijske tehnologije | | | | | | | | 2 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Information and communications technologies | | | | | | | | 2 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni-strokovni /elective professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64303 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 45 | 0 | | | 30 | | | 0 | | | | 0 | | | 75 | |  | 6 |
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| **Nosilec predmeta / Lecturer:** | | | | | Boštjan Batagelj | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian  angleški (mentorsko) / English (consultations) | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian  angleški (mentorsko) / English (consultations) | | | | | | | | | | | |
| **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):** | | | | | | | |
| Osnove nebesne mehanike, Kepler-jevi zakoni, enačba tirnice satelita, uporabne tirnice satelitov in njihove lastnosti, prevoz satelita v tirnico in popravki tirnice. Vesoljsko okolje, uravnavanje lege in temperature satelita, izvori energije na krovu. Lastnosti radijskih zvez Zemlja-satelit, satelit-satelit in satelit-Zemlja, Doppler-jev pomik v satelitskih zvezah.  Načrtovanje telekomunikacijske opreme za satelitske zveze točka-točka, za radiodifuzijo, za mobilno telefonijo, za telekomando in telemetrijo satelita. Zemeljska radionavigacija: pomorska (LORAN), zrakoplovna (VOR, DME, ILS), določanje položaja preko sistemov mobilne telefonije GSM in UMTS. Satelitska radionavigacija: Doppler-jevi sistemi Transit in Cikada, 3-D sistemi GPS, GLONASS in GALILEO. Primarni in sekundarni radarji, pulzni in FM radarji, Doppler-jevi radarji. Daljinsko zaznavanje, pasivna radiometrija, aktivni radar s sintetično odprtino. | | | | | | | |  | | Fundamentals of celestial mechanics, Kepler's laws, equation of satellite orbit, useful satellite orbits and their properties, transport of the satellite into orbit and trajectory adjustments. Space environment, managing the location and temperature of satellite, power sources on board the satellite. Properties of radio links Earth-satellite, satellite-satellite and satellite-Earth, Doppler shift in satellite communications. Design of satellite telecommunications equipment for point-to-point links, broadcasting, mobile telephony, satellite tele-command and telemetry. Ground navigation: Maritime (LORAN) Aeronautical (VOR, DME, ILS), positioning systems based on GSM and UMTS mobile telephony.  Satellite radio-navigation: Doppler systems Transit and Cikada, 3-D systems GPS, GLONASS and GALILEO. Primary and secondary radar, pulse and FM radars, Doppler radars. Remote sensing, passive radiometry, active radar with synthetic aperture. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. BATAGELJ, Boštjan. Satelitske komunikacije: študijsko gradivo. Ljubljana: Fakulteta za elektrotehniko, Laboratorij za sevanje in optiko, 2013. <http://lso.fe.uni-lj.si/studij/skn/gradivo/satelitske_komunikacije%20_Batagelj.pdf> 2. BATAGELJ, Boštjan. Zbirka rešenih nalog iz satelitskih komunikacij. Ljubljana: Fakulteta za elektrotehniko, Laboratorij za sevanje in optiko, 2012. http://lso.fe.uni-lj.si/studij/skn\_vs/gradivo/nalogeSK\_1\_3.pdf 3. Matjaž Vidmar. Radiokomunikacije. 1. izd. Ljubljana: Fakulteta za elektrotehniko, 2005. ISBN 961-243-026-8. 4. Matjaž Vidmar. Laboratorijske vaje iz radiokomunikacij. 1. izd. Ljubljana: Fakulteta za elektrotehniko, 2000. ISBN 961-6210-79-3. 5. KOSTEVC, Drago. Navigacijske naprave in sistemi. 1. izd. Ljubljana: Založba FE in FRI, 2011. VI, 89 str., ilustr. ISBN 978-961-243-192-1. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznavanje osnovnih zakonitosti vesoljske tehnike, možnosti in omejitve radijskih zvez s  plovilom v vesolju. Spoznavanje lastnosti satelitskih komunikacij. Spoznavanje osnov  zemeljske in satelitske radionavigacije, radio lokacije ter daljinskega zaznavanja. | |  | | The purpose of this course is to provide principles and techniques of satellite radio links and basic of navigation systems. Understanding the basic laws of space technology, the possibilities and limitations of communication links with the space orbiter. Understanding the basics of ground and satellite radio-navigation, radiolocation, and remote sensing. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Poznavanje in razumevanje osnov vesoljske tehnike s poudarkom na  komunikacijah in radionavigaciji.  Uporaba:  Pridobljeno znanje je nujno za razumevanje delovanja in načrtovanja satelitskih in satelitske navigacije, radarjev in daljinskega zaznavanja.  Refleksija:  Za proizvajalce telekomunikacijske opreme kot tudi ponudnike telekomunikacijskih storitev je bistvenega pomena, da imajo usposobljen kader, ki razume tudi dogajanja na najnižjem, fizičnem nivoji.  Prenosljive spretnosti:  Sintetično obravnavanje problemov, načrtovanje sistemov na osnovi poznavanja lastnosti vesoljske tehnike, enciklopedično razvrščanje podsistemov satelitske komunikacije in navigacije. | | |  | Knowledge and understanding:  Understanding the basics of space satellite technology with an emphasis on communications and radio-navigation.  Application:  The acquired knowledge will be useful in the design and use of satellite and navigation systems.  reflection:  For providers of satellite communications and navigation services, it is essential to have qualified staff that is familiar with the basic principles of operation and characteristics of satellite systems on a physical level.  Transferable skills:  Synthetic problem solving, systems design based on knowledge of the properties space techniques, encyclopedic classification subsystems, satellite communications and navigation. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja na katerih se študent seznani s teoretičnimi osnovami, in laboratorijske vaje, kjer nekaj problemov spozna tudi praktično in jih skuša v duhu timskega dela reševati. | | |  | Lectures, where students are introduced by the theoretical basics and laboratory courses, where some of the problems are solved practically. | |
| **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.  Pozitivna ocena laboratorijskih vaj je pogoj za pristop k izpitu.  Prispevki k oceni:  pravljene laboratorijske vaje s končnim poročilom  pisni izpit  ustni izpit | 30%  50%  20% | | | | Type: laboratory exercises, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of laboratory exercises is a prerequisite for the exam.  Contributions to final grade:  laboratory coursework with final report  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. BATAGELJ, Boštjan, PAVLOVIČ, Leon, NAGLIČ, Luka, TOMAŽIČ, Sašo. Convergence of fixed and mobile networks by radio over fibre technology,. Inf. MIDEM, jun. 2011, letn. 41, št. 2, str. 144-149. 2. STOPAR, Bojan, STANIČ, Samo, BATAGELJ, Boštjan, ŠTERN, Andrej, KAMNIK, Roman, BERK, Sandi, FILJAR, Renato, DIMC, Franc (avtor, urednik). Forum GNSS.SI : po prvem srečanju. Portorož: Fakulteta za pomorstvo in promet, 2013. 49 str., ilustr. ISBN 978-961-6044-97-4. 3. MLINAR, Tomi, BATAGELJ, Boštjan. Prihodnost, načrtovanje in razvoj brezžičnih širokopasovnih omrežij. Elektrotehniški vestnik, ISSN 0013-5852, 2013, letn. 80, št. 4, str. 165-170 4. FRÖHLICH, Hubert, BATAGELJ, Boštjan. Širokopasovni mobilni dostop preko satelitskih komunikacij. V: UMEK, Anton (ur.), KOS, Anton (ur.), SODNIK, Jaka (ur.), HUDOBIVNIK, Alojz (ur.). Triindvajseta delavnica o telekomunikacijah, 23 in 24. november 2009, Brdo pri Kranju. *Širokopasovna mobilna omrežja : zbornik referatov*, (VITEL). Ljubljana: Elektrotehniška zveza Slovenije, cop. 2009, str. 40-43. 5. RODIČ, Tomaž, OŠTIR, Krištof, MATKO, Drago, BATAGELJ, Boštjan, PELJHAN, Marko, MALIČ, Barbara, ZWITTER, Tomaž, ŠUŠTAR, Tomaž. Small satellites technologies from newcomers perspective - Slovenian Space-Si case. V: 24th Annual AIAA/USU Conference on Small Satellites, August 9-12, '10, Logan, USA. *Connecting the dots : bringing visionaries, system implementers & mission sponsors together : proceedings*. [Logan: Utah State University], 2010, str. 1-10. | | | | | |