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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Prenosni sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Transmission systems | | | | | | | | | | | | | | |
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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 | | | | | Elektronika | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Electronics | | | | | | | | 1 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64222 | | | | | |
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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 |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Sašo Tomažič | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovene | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovene | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the year of the course. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Osnovni model digitalnega prenosa Osnovni pojmi teorije informacij (verjetnost, informacija, naključna spremenljivka, izvor informacije, entropija, redundanca). Brez-izgubno izvorno kodiranje (izločanje redundance). Izgubno izvorno kodiranje (izločanje irelevance). Informacijski kanal. Binarni simetrični kanal. Gaussov kanal. Vzajemna entropija in kapaciteta informacijskega kanala. Kanalsko kodiranje. Kodirni postopki za odkrivanje in odpravljanje napak. Primeri kanalskega kodiranja (nekodiran prenos, blokovne kode, konvolucijske kode, mrežni diagram). Dekodiranje na osnovi največje verjetnosti. Viterbi algoritem.  Prenos signalov v osnovnem pasu. Linearno popačenje in intersimbolna interferenca. Nyquistov kriterij za prenos brez intersimbolne interference. Izravnava karakteristike kanala in izločanje intersimbolne interference. Spekter signalov v osnovnem pasu in spektralna učinkovitost.  Prenos signalov v višjih frekvenčnih legah. Digitalni modulacijski postopki (amplitudna frekvenčna in fazna modulacija). Primeri digitalnih modulacijskih postopkov (PAM, FSK, PSK, DPSK, CPM, MSK, GMSK, QAM). Prenos z razširjenim spektrom. Načini sodostopa do skupnega prenosnega medija. | | | | | | | |  | | The basic model of digital transmission. Basic concepts of information theory (probability, information, random variables, information sources, entropy, redundancy). Lossless source coding (elimination of redundancy). Loosely source coding (elimination of irrelevance). Information channel. Binary symmetric channel. Gaussian channel. Mutual entropy and information channel capacity. Channel coding. Error detecting and error correcting codes.. Examples of channel coding (uncoded transmission, block codes, convolution codes, trellis diagram). Maximum likelihood decoding. Viterbi algorithm.     Baseband transmission. Linear distortion and inter-symbol interference (ISI). Nyquist criterion for ISI free transmission. Adaptive equalization and ISI cancellation. Spectrum of baseband signals and spectral efficiency.     Transmission of signals in the higher frequency bands. Digital modulation (amplitude, phase, and frequency modulation). Examples of digital modulation (PAM, FSK, PSK, DPSK, CPM, MSK, GMSK, QAM). Spread spectrum. Multiple access to a common transmission medium. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Tomažič, S., Osnove telekomunikacij I, Založba FE in FRI, Ljubljana 2002, ISBN 961-6210-97-1 2. Haykin, S., Communication systems, 4th edition, John Wiley & Sons, New York, 2001, 816 str. ISBN 0-471-17869-1 3. Glover, I., Grant, P., Digital communications, Prentice Hall, London 1998, 734 str., ISBN 0-13- 565391-6 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Predmet podaja temeljna znanja s področja prenosa informacijskih signalov, kar predstavlja osnovo vseh sodobnih komunikacijskih sistemov. Namen predmeta je seznaniti bodoče inženirje elektronike s teoretičnimi osnovami učinkovitega in zanesljivega prenosa digitalnega signala preko neidealnega komunikacijskega kanala. Predstavljena teorija nudi koristno osnovo za predmete na drugi stopnji študija elektronike. Poleg teoretskih osnov pa je pri predmetu podan tudi pregled obstoječih rešitev, ki daje študentu osnovno razumevanje delovanja obstoječih komunikacijskih sistemov, s katerimi se srečuje v vsakdanjem življenju. | |  | | The course provides basic knowledge in the field of the transmission of information signals, which is the basis of all modern communication systems. The purpose of the course is to acquaint the future engineers with the theoretical basics of efficient and reliable transmission of digital signals through the non-ideal communication channel. The theory provides a useful basis for the subjects in the second degree of the study. In addition to the theoretical foundations an overview of existing solutions is given, which gives the students a basic understanding of the existing communication systems faced in their everyday life. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Poznavanje in razumevanje osnovnih načel digitalnega prenosa, motenj in napak, ki jih motnje povzročajo, ter postopkov za odpravljanje napak in učinkovito izkoriščanje frekvenčnega prostora. | | |  | Knowledge and understanding of the basic principles of digital transmission, errors caused by interference, and procedures for error correction and efficient use of the frequency space. | |
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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 on which the student is acquainted with the theoretical basics and lab work, where he learns how to solve some practical problems in the spirit of teamwork. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, projekt, 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:   * laboratorijske vaje in projekt * ustni izpit | 25%  75% | | | | Type: laboratory exercises, project, 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 the final grade:   * laboratory exercises and project * oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. TOMAŽIČ, Sašo. Spectral efficiency. Encyclopedia of wireless and mobile communications. Boca Raton; New York: Taylor & Francis Group: Auerbach Publications, cop. 2008, vol. 2, str. 1095-1099. 2. TOMAŽIČ, Sašo. Comments on spectral efficiency of VMSK. IEEE transactions on broadcasting, 2002, vol. 48, no. 1, str. 61-62. 3. TOMAŽIČ, Sašo. Risidual noise reduction in sign algorithm. IEEE signal processing letters, 2000, vol. 7, no. 8, str. 233-234. 4. TOMAŽIČ, Sašo, ŠTULAR, Mitja. Razširjeni spekter v mobilnih komunikacijah: (1) Sistemi z raširjenim spektrom. Elektrotehniški vestnik, 1998, let. 65, št. 5, str. 303-310. 5. BERTOK, Jurij, TOMAŽIČ, Sašo. Sekvenčno dekodiranje konvolucijskih kod. Elektrotehniški vestnik, 1991, let. 58, št. 5, str. 291-301. | | | | | |