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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Modul K: Visokofrekvenčna tehnika | | | | | | | | | | | | | | |
| **Course title:** | | | Module K: High-frequency technology | | | | | | | | | | | | | | |
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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:** | | | | | | | | | | | | 64304 | | | | | |
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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:** | | | | | Matjaž Vidmar | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **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):** | | | | | | | |
| Visokofrekvenčni polprevodniki: diode in tranzistorji. Različni polprevodniki: prepovedan energijski pas in mobilnost nosilcev. Delovna točka ojačevalnika, razredi A,B,C. S-parametri. Stabilnost ojačevalnika. Toplotni šum ojačevalnika. Šumno število. Meritev šuma. Zasičenje ojačevalnika, definicija P1dB. Inter-modulacijsko popačenje, presečna točka IMD. Nelinearna visokofrekvenčna vezja: mešalnik in omejevalnik. Koncentrirani LC in votlinska električna sita. Piezoelektrični mehanski resonatorji, kremenčevi kristali in SAW naprave. Električni oscilatorji. Kratkoročna in dolgoročna stabilnost. Fazni šum oscilatorja. Frekvenčni sintetizatorji. Fazno-sklenjene zanke, stabilnost zanke in fazni šum. Izvedba radijskega oddajnika. Zasnova radijskega sprejemnika: homodinski, heterodinski in ničelna medfrekvenca. Izločanje nosilca in takta v sprejemniku. | | | | | | | |  | | High-frequency semiconductor devices: diodes and transistors. Different semiconductors, band-gap and carrier mobility. Amplifier operating point, classes A,B,C. S-parameters. Amplifier stability. Amplifier thermal noise. Noise figure. Noise measurements. Amplifier saturation, definition of P1dB. Inter-modulation distortion, IMD intercept point. Non-linear high-frequency circuits: mixer and limiter. Lumped LC and cavity electrical filters. Piezoelectric mechanical resonators, quartz crystals and SAW devices. Electrical oscillators. Short-term and long-term stability. Oscillator phase noise. Frequency synthesizers. Phase-locked loops, loop stability and phase noise. Implementation of radio transmitters. Basic designs of radio receivers: homodyne, heterodyne and zero intermediate-frequency designs. Carrier and clock recovery in radio receivers. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Priročnik za laboratorijske vaje: http://antena.fe.uni-lj.si/literatura/vt.pdf 2. Kostevc, D., Poglavja iz mikrovalov, Založba FE in FRI, Ljubljana, 2005 3. Vidmar, M., Radiokomunikacije, Založba FE in FRI, Ljubljana, 2005 4. Vidmar, M., Laboratorijske vaje iz Radiokomunikacij, Založba FE in FRI, Ljubljana, 2000 5. <http://antena.fe.uni-lj.si/literatura/> | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznavanje specifičnih elementov vezij in sistemov za visoke frekvence. Spoznavanje specifičnih postopkov meritev, analize in sinteze vezij za visoke frekvence. Spoznavanje osnovnih sistemskih znanj o radio-komunikacijah. | |  | | Learning specific circuit components and systems for high frequencies. Learning specific methods of measurements, analysis and synthesis of high-frequency circuits. Learning fundamental system knowledge of radio communications. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Delovanje, načrtovanje in meritve gradnikov radijskih zvez. | | |  | Knowledge and understanding:  Operation, design and measurements of radio-link components. | |
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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 to explain the theoretical background and laboratory experiments to practically confirm the theory in the spirit of team work. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt)  pisne tihe vaje  poročila laboratorijskih vaj  ustno izpraševanje | 50%  50%  po potrebi/  if required | | | | ype (examination, oral, coursework, project):  multiple written exams  written laboratory reports  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. BOGATAJ, Luka, VIDMAR, Matjaž, BATAGELJ, Boštjan. Opto-electronic oscillator with quality multiplier. IEEE transactions on microwave theory and techniques, ISSN 0018-9480. [Print ed.], Feb. 2016, vol. 64, no. 2, str. 663-668. 2. TRATNIK, Jurij, LEMUT, Primož, VIDMAR, Matjaž. Time-transfer and synchronization equipment for high-performance particle accelerators = Prenos takta in sinhronizacijska oprema za visoko-zmogljive pospeševalnike osnovnih delcev. Informacije MIDEM, ISSN 0352-9045, jun. 2012, letn. 42, št. 2, str. 115-122. 3. STEED, Robert J., PAVLOVIČ, Leon, NAGLIČ, Luka, VIDMAR, Matjaž, et al. Hybrid integrated optical phase-lock loops for photonic terahertz sources. IEEE journal of selected topics in quantum electronics, ISSN 1077-260X. [Print ed.], Jan./Feb. 2011, vol. 17, no. 1, str. 210-217. 4. TRATNIK, Jurij, VIDMAR, Matjaž. 2.8 GHz - 5.7 GHz very fast UWB CCO using discrete-packaged SiGe RF transistors = 2,8 GHz - 5,7 GHz zelo hiter ultra širokopasoven tokovno krmiljen oscilator z diskretnimi SiGe RF tranzistorji. Informacije MIDEM, ISSN 0352-9045, mar. 2011, letn. 41, št. 1, str. 70-72. 5. RASPOR, Adam, VIDMAR, Matjaž. Two double-ring cavity antennas in 19-22 dBi directivity range. Electronics letters, ISSN 0013-5194. [Print ed.], Dec. 2009, vol. 45, no. 25, str. 1288-1289. | | | | | |