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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Linearna elektronika | | | | | | | | | | | | | | |
| **Course title:** | | | Linear Electronics | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | **Elektronika** | | | | | | | | 3. | | zimski | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **Electronics** | | | | | | | | **3.** | | **winter** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni- strokovni/compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64144 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** |  | | | **45** | | |  | | | |  | | | **85** | |  | **7** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Andrej Žemva | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski | | | | | | | | | | | |
| **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):** | | | | | | | |
| Unipolarni tranzistor (FET) in osnovne ojačevalne stopnje. Bipolarni tranzistor (BJT) in osnovne ojačevalne stopnje. Enosmerna analiza za določitev delovne točke, malosignalna analiza za izračun prenosne funkcije vezja.  Frekvenčna odvisnost. Prenosna funkcija in Bodejevi diagrami. Frekvenčni odziv FET in BT. Tokovna zrcala in aktivna bremena. Tokovna zrcala s FET in BT. Aktivna bremena s FET in BT.  Diferencialni in večstopenjski ojačevalniki. Diferencialna stopnja: osnovni princip delovanja, model DC in AC, protifazno in sofazno krmiljenje, CMRR z BT, MOSFET in JFET.  Preprosta izvedba operacijskega ojačevalnika z diferencialnim BT in izhodno stopnjo.  Povratne vezave (PV). Koncept PV, prednosti in slabosti PV. Analiza vezij s PV, vpliv PV na ojačanje in frekvenčni pas. Osnovne topologije PV. Praktični primeri vezij s PV.  PV in stabilnost. Nyquistov kriterij stabilnosti, amplitudna in fazna meja. Principi frekvenčne kompenzacije. Primeri uporabe: ojačevalnik FET s PV. | | | | | | | |  | | Unipolar transistor (FET) and basic amplifier stages. Bipolar transistor (BJT) and basic amplifier stages. DC circuit analysis for determining quiescent point, small signal analysis and calculation of circuit transfer function.  Frequency response. Circuit transfer function and Bode plots. Frequency response of FET and BT. Current mirrors and active loads. Current mirrors with FET and BT. Active loads with FET and BT.  Differential and multi-stage amplifiers. Differential stage: basic principle of operation, DC and AC model, differential and common mode input signal, CMRR of FET, MOSFET and JFET. Simple implementation of operational amplifier with differential BT and output stage.  Feedback. Concept of feedback, advantages and disadvantages. Analysis of circuits with feedback. Feedback influence on gain and bandwidth. Basic feedback topologies and examples of circuits with feedback. Feedback and stability. Nyquist stability criterion, gain and phase margins. Principle of frequency compensation. Design application: MOSFET feedback circuit. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. NEAMEN, Donald A. Microelectronics: Circuit Analysis and Design. 4th Edition. McGraw-Hill. 2011.  2. ŽEMVA, Andrej. Linearna elektronika.Gradivo za laboratorijske vaje. 2014. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Predmet podaja temeljna znanja s področja linearne elektronike in obravnava osnovne ojačevalne stopnje, njihovo analizo in modeliranje, frekvenčno odvisnost, povratne vezave in stabilnost vezij. Pridobljena znanja so osnova za vse nadaljnje predmete s področja analognih in analogno-digitalnih elektronskih vezij. | |  | | Solid knowledge of linear electronics and basic amplifier stages, analysis and modeling, frequency response, feedback and stability. Gained knowledge forms the solid basis for all further courses on analog and mixed signal electronic circuits. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Študent bo osvojil analizo elektronskih vezij in spoznal temeljne principe linearne elektronike. Osvojil bo znanja s področja eno in večstopenjskih ojačevalnikov, frekvenčne odvisnosti, povratnih vezav in njihovega vpliva na stabilnost. | | |  | Student will master analysis of electronic circuits, linear electronics, single and multi-stage amplifiers, frequency response, feedback and stability. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, avditorne in laboratorijske vaje za utrditev teoretičnih osnov. | | |  | Lectures and tutorials. | |
| **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:  laboratorijske vaje  pisni izpit  ustni izpit | 10%  70%  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 exercises  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. MOČNIK, Jure, ŽEMVA, Andrej. Controlling voltage profile in smart grids with remotely controlled switches. *IET generation, transmission & distribution*, 2014, vol. 8 , no. 8, str. 1499-1508.  2. TOMAŽIČ Jure, ŽEMVA, Andrej., Efficient and lightweight battery management system contributes to victory in the Green Flight Challenge 2011. *Electric power systems research*, 2013, vol. 98, no. 5, str. 70-76.  3. TAVČAR, Rok, DEDIČ, Jože, BOKAL, Drago, ŽEMVA, Andrej. Transforming the LSTM training algorithm for efficient FPGA-based adaptive control of nonlinear dynamic systems, *Informacije MIDEM*, 2013, vol. 43, no. 2, str. 131-138.  4. SLUGA, Janez, ZALETELJ, Viktor, ŽEMVA, Andrej. Agent control for reconfigurable open kinematic chain manipulators. *International journal of advanced robotic systems*, 2013, vol. 10, no. 353, str. 1-13.5.  5. BAŠA, Kristjan, ŽEMVA, Andrej. Simulation and verification of a dynamic model of the electric forklift truck. *Intelligent automation and soft computing*, 2011, vol. 17, no. 1, str. 13-30. | | | | | |