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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Robotski mehanizmi | | | | | | | | | | | | | | |
| **Course title:** | | | Robotic Mechanisms | | | | | | | | | | | | | | |
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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 | | | | | Robotika | | | | | | | | 2 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Robotics | | | | | | | | 2 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64295 | | | | | |
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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:** | | | | | Marko Munih, Jadran Lenarčič | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian  angleški / English | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian  angleški / English | | | | | | | | | | | |
| **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):** | | | | | | | |
| Redundantni mehanizmi (primarna in sekundarna naloga, kinematična redundanca, hiperredundanca); Paralelni mehanizmi (značilnosti paralelnih mehanizmov, vezljivost nog in stopnje prostosti ploščadi, kinematične enačbe); Robotski dotik (osnovni dotiki, modeli dotikov); Robotski prijem (prijem z dvema prstoma, prijem z več prsti, matrika prijema); Tetivni mehanizmi (kinematika, statika in vodenje tetivnih sistemov); Robotski trk; Humanoidni robotski mehanizmi. | | | | | | | |  | | Redundant mechanisms (primary and secondary task, kinematic redundancy, hiperredundancy); Parallel mechanisms (characteristics of parallel mechanisms, connectivity of legs and degrees of freedom, kinematic equations); Robot contact (basic contacts, contact models); Robot grasp (robot grasp with two fingers, robot grasp with multiple fingers, grasp matrix); Tendon systems (kinematics, statics and tendon system control); Humanoid robot mechanisms; | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. J. Lenarčič, T. Bajd, M. Stanišić: Robot mechanisms, Springer, 2013.  2. R. M. Murray, Z. Li, S. S. Sastry: A Mathematical Introduction to Robotic Manipulation, CRC 3. Press, Boca Raton, 1994.  4. L.W. Tsai: Robot Analysis: The Mechanics of Serial and Parallel Manipulators, John Wiley&Sons, Inc., New York, 1999.  5. M.W. Spong, S. Hutchinson, M. Vidyasagar: Robot Modeling and Control, John Wiley&Sons, Inc., New York, 2005.  6. M.T. Mason: Mechanics of Robotic Manipulation, The MIT Press, Cambridge, 2001. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Študent spozna najsodobnejše robotske mehanizme, kot so paralelni roboti in večprstna robotska prijemala. Predstavljeni so tudi mehanizmi humanoidnih robotov. Pri praktičnem delu študentje delajo v laboratoriju z redundantnimi sistemi (mobilni robot in manipulator) ter robotskimi prijemali in merilnimi rokavicami. Gradijo bipedalne hodeče robote in programirajo humanoidne robote. | |  | | The student becomes familiar with newest robot mechanisms, the parallel robots and mutifinger grippers. Presented are also mechanisms of humanoid robots. Within the practical part of the course students work in lab with redundant systems (mobile robot and manipulator), robot grippers and measurement gloves. They build bipedal walking robots and program humanoid robots. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Poznavanje specialnih robotskih mehanizmov. | | |  | Knowledge and understanding:  Knowledge about special robot mechanisms. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Študenti imajo na voljo učbenik, ki obsega predavano snov. Del snovi predava vabljeni predavatelj z raziskovalnega inštituta. Občasno so vabljeni tudi tuji predavatelji. Praktično delo poteka v obliki projektnih nalog v laboratorijih fakultete in inštituta. Študenti delajo v manjših skupinah. | | |  | Students have available textbook with the course topics. Part of the course is given by invited lecturer from the research institute. Occasionally are invited also lecturers from abroad. Practical work is commencing in form of projects in the labs of Faculty and the Institutes. Students cooperate in a smaller groups. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Pisni/ustni izpit: od 6 do 10 pozitivno, od 1 do 5 negativno  Pisno poročilo ob koncu praktičnih laboratorijskih vaj.  Zahtevana je obvezna prisotnost pri praktičnih vajah. Študent pripravi poročila za posamezne opravljene projekte. Pisni izpit obsega naloge in vprašanja iz obravnavane snovi.  Prispevki k oceni:  vaje  izpit | 50%  50% | | | | Witten/oral exam: from 6 to 10 positive, from 1 to 5 negative.  Written report at the end of project period is required. Presence is obligatory during practical exercises. Student prepares report for each project. The written exam contains cases and questions in the fields of course.  Contributions to final grade:  exercises  exam |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. BAJD, Tadej, MIHELJ, Matjaž, MUNIH, Marko. Introduction to robotics, Springer, 2013. 2. REJC, Jure, KOVAČIČ, Franc, TRPIN, Anton, TURK, Igor, ŠTRUS, Miran, REJC, Danilo, OBID, Pavle, MUNIH, Marko. The mechanical assembly dimensional measurements with the automated visual inspection system. Expert syst. appl., 2011, vol. 38, no. 8, str. 10665-10675. 3. AMBROŽIČ, Luka, GORŠIČ, Maja, GEEROMS, Joost, FLYNN, Louis, LOVA, Molino, KAMNIK, Roman, MUNIH, Marko, VITIELLO, Nicola. Cyberlegs : a user-oriented robotic transfemoral prosthesis with whole-body awareness control. IEEE robotics & automation magazine, ISSN 1070-9932, 2014, vol. 21, no. 4, str. 82-93. 4. GAMS, Andrej, IJSPEERT, Auke Jan, SCHAAL, Stefan, LENARČIČ, Jadran. On-line learning and modulation of periodic movements with nonlinear dynamical systems. Autonomous robots, 2009, vol. 27, no. 1, str. 3-23. 5. LENARČIČ, Jadran, BAJD, Tadej, STANIŠIĆ, Michael M.. Robot mechanisms, (International series on Intelligent systems, control and automation, Springer, 2013. | | | | | |