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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Osnove robotike | | | | | | | | | | | | | | |
| **Course title:** | | | Introduction to Robotics | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni dodiplomski študijski program 1. stopnje Elektrotehnika | | | | | **Vse smeri, Avtomatika** | | | | | | | | **3** | | **zimski** | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **All fields, Control Systems** | | | | | | | | **3** | | **winter** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni in izbirni – strokovni / Compulsory and elective professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64126 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **30** | | | **-** | | | | **-** | | | **65** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | Marko Munih | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski / English** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski / English** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik študija, opravljeni izpiti Matematika I/IIm Mehanika in temodinamika. | | | | | | | | |  | Enrolment in the year of the course, exams passed in Mathematics I/II, Mechanics and termodynamics | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Uvod (prostostne stopnje, robotski manipulator, robotske roke, robotsko zapestje in prijemalo, robotski delovni prostor); Homogene transformacije (položaj, orientacija, lega, premik, perspektiva); Skalarni Denavit-Hartenbergov geometrijski model robotskega mehanizma (cilindrični, sferični, SCARA, antropomorfni robotski manipulator, sferično zapestje). Vektorski geometrijski model robotskega mehanizma (cilindrični, sferični, SCARA, antropomorfni robotski manipulator, sferično zapestje). Inverzni geometrijski model robotskega mehanizma. Rotacija in orientacija v prostoru (Eulerjevi in RPY koti, Rodriguesova formula, kvaternioni). | | | | | | | |  | | Introduction (industrial robot manipulator, robot vehicles, man-robot systems, biologically inspired robots, serial chain of segments and joints); Homogenious transformations (position, orientation, pose, traslation, perspective); Scalar Denavit-Hartemberg geometric model of robot mechanism (cylindrical, spherical, SCARA, antropomorphic, spheric wrist); Vector model of robot mechanism (cylindrical, spherical, SCARA, anthropomorphic, spheric wrist); Inverse geometry model of robot mechanism, Rotation and orientation (Euler and RPY angles, Rodrigues formula, quaternions). | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. T. Bajd, M. Mihelj, M. Munih: Introduction to robotics, Springer, 2013.  2. T. Bajd, J. Lenarčič, M. Mihelj, A. Stanovnik, M. Munih: Robotics, Springer, 2010.  3. T. Bajd, M. Mihelj, M. Munih: Osnove robotike, Založba FE in FRI, 2011.  4. J.B. Kuipers: Quaternions and Rotation Sequences, Princeton University Press, Princeton, 1999.  5. L. Sciavicco, B. Siciliano: Robotics: Modelling, Planning and Control, Springer, 2009. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Osnove robotike so predmet, kjer se študent prvič sreča z roboti. Obravnavajo geometrijske modele robotskih mehanizmov, vendar na tako splošen način, da je pridobljeno znanje uporabno tudi pri razvoju in uporabi programskih orodij navideznih okolij, strojnega vida in računalniške grafike. Pri praktičnem delu predmeta se študentje v manjših skupinah temeljito naučijo programirati sodobne industrijske robote in uporabljati robotska CAD okolja. | |  | | Introduction to robotics is a course, where the student first meets the robots. The course deals with geometrical models of robot mechanisms in a very general way that the knowledge is efficiently used also in problems on the fields of virtual environment, machine vision and computer graphics. For the lab part of the course students are grouped into small groups to acquire skills in industrial robot programming and use of robotic CAD tools. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Znanje opisov lege s homogenimi transformacijskimi matrikami, razumevanje različnih pristopov za načrtovanje geometrijskih modelov robotskih mehanizmov, razumevanje različnih pristopov opisa orientacije in rotacije. | | |  | Knowledge and understanding:  Knowledge about pose descriptions with homogenious transformation matix, understanding various approaches to the design of geometry models in robot mechanisms,  understanding different types of orientation and rotation description. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Študenti imajo na voljo skripta z zgoščeno vsebino predmeta. Na predavanjih je predstavljeno večje število primerov za vsako obravnavano poglavje. Nekatera področja uporabe robotov so posebej predstavljena v "video predavanjih" (robotika v medicini, razvedrilna robotika, hodeči roboti, mobilni roboti, robotska prijemala, servisna robotika, robotski vid, rehabilitacijska robotika). Redno so vabljeni predavatelji iz slovenske industrije in raziskovalnih inštitutov. Občasno so vabljeni tudi tuji predavatelji. Praktične vaje potekajo na večjem številu sodobnih industrijskih robotov. Študentje delajo v manjših skupinah. Posebna pozornost je posvečena varnosti pri delu z roboti. | | |  | Students have available books with condensed content. Within the lectures there is presented larger number of cases for each chapter. Some robot areas are presented by using "video lectures" (robots in medicine, entertainment robotics, walking robots, mobile robots, robot grippers, service robotics, robot vision, rehabilitation robotics). Regularly are invited speakers from Slovenian industry and research institutes. Occasionally are invited speakers form abroad. Lab exercises offer also work on larger number of modern industrial robots. Students cooperate in smaller groups. Special care is taken to a security issues in proximity with robots. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Pisni/ustni izpit: od 6 do 10 pozitivno, od 1 do 5 negativno  Zahtevana je obvezna prisotnost pri praktičnih vajah. Študent pripravi poročila za posamezne projekte. Pismeni izpit obsega reševanje primerov: opis premikov teles s homogenimi transformacijami, geometrijski modeli standardnih robotskih rok, opis rotacije in orientacije teles z in kvaternioni. | **izpit/exam**  **50%**  **vaje/lab**  **50%** | | | | Witten/oral exam: from 6 to 10 positive, from 1 to 5 negative.  Presence during practical exercises is obligatory. Student prepares report for each project. The written exam contains problem solving: description of body displacements, geometrical models for standard robot arms, description of rotation and orientation and quaternions. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. BAJD, Tadej, MIHELJ, Matjaž, MUNIH, Marko. Introduction to robotics, Springer, 2013.  2. BAJD, Tadej, MIHELJ, Matjaž, LENARČIČ, Jadran, STANOVNIK, Aleš, MUNIH, Marko. Robotics, Springer, 2010.  3. 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.  4. ČINKELJ, Justin, KAMNIK, Roman, ČEPON, Peter, MIHELJ, Matjaž, MUNIH, Marko. Closed-loop control of hydraulic telescopic handler. Autom. constr., 2010, vol. 19, no. 7, str. 954-963.  5. PODOBNIK, Janez, MUNIH, Marko. Haptic interaction stability with respect to grasp force. IEEE trans. syst. man cybern., Part C Appl. rev., 2007, vol. 37, no. 6, str. 1214-1222. | | | | | |