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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Vgradni sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Embedded 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 | | | | | Avtomatika in informatika | | | | | | | | 1 | | 2 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Control systems and computer engineering | | | | | | | | 1 | | 2 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64202 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **0** | | | **45** | | |  | | | |  | | | **75** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | Stanislav Kovačič | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenščina / Slovenian** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenščina / Slovenian** | | | | | | | | | | | |
| **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):** | | | | | | | |
| Uvod, bistvene arhitekturne lastnosti vgradnih sistemov, napredni vgradni sistemi, področja in primeri uporabe.  Koncepti operacijskih sistemov (OS). OS v realnem času. OS za vgradne sisteme.  Linux, pregled sistemskih klicev in funkcij.  Upravljanje procesov/opravil, večopravilnost, večnitnost. Upravljanje pomnilnika. Razvrščanje procesov/opravil. Sistemski klici in funkcije za upravljanje procesov/niti. Primeri v programskem jeziku C/C++.  Medprocesne komunikacije, kritično področje, sinhronizacija, semaforji, signali, deljen pomnilnik, cevi, sporočila. Sinhronizacija niti. Sistemski klici in funkcije, s primeri v programskem jeziku C/C++.  Koncepti komunikacijskih omrežij, ISO OSI, TCP/IP, protokoli in storitve. Model odjemalec strežnik. Programski vmesnik komunikacijskih vtičnic s primeri v jeziku C/C++.  Čas in upravljanje časa. Časovniki. Sistemi v realnem času. Razvrščanje v sistemih realnega časa. Primeri v jeziku C/C++.  Večprocesorski sistemi, oblike paralelizmov, pohitritev, učinkovitost, načrtovanje paralelnih/porazdeljenih algoritmov in programov. | | | | | | | |  | | Introduction, embedded systems architectures, advanced embedded systems, application domains, and a few examples.  Operating systems (OS) concepts, real-time OS,  embedded OS.  Linux, system calls and functions overview.  Processes, multi-tasking, multi-threading. Memory management.  Scheduling. System calls for process/thread control. Examples in C/C++.  Inter-process communications (IPC), critical section, synchronization, semaphores, signals, shared memory, pipes, and messages. Thread synchronization. System calls for IPC. Examples in C/C++.  Principles of computer networks, ISO OSI and TCP/IP. Client-server model. Sockets API, examples in C/C++.  Time management. Timers. Real-time (RT) systems. Scheduling in RT systems.  Examples in C/C++.  Multi-processor systems, parallelisms, speed-up, efficiency. Selected topics in parallel/distributed systems design. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. M. Kerrisk, The Linux Programming Interface, No Starch Press, Inc., 2010. 2. R. Stevens, S. Rago, Advanced programming in the UNIX environment, 3rd Ed., Addison Wesley, 2013. 3. Vgradni sistemi, Študijsko gradivo izvajalcev predmeta, predloge predavanj, predloge laboratorijskih vaj. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Razumevanje osnovnih načel ter uporaba sodobnih tehnologij in rešitev v naprednejših vgradnih sistemih za avtomatiko in robotiko. | |  | | To understand fundamental concepts and to be able to apply modern solutions and technologies to embedded systems for automation/robotics. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Razumevanje osnovnih načel zgradbe in delovanja vgradnih sistemov za avtomatiko in robotiko.  Razumevanje osnovnih načel operacijskih sistemov za vgradne, realnočasovne sisteme.  Načrtovanje in razvoj programske opreme vgradnih sistemov temelječih na operacijskih sistemih za realni čas. | | |  | Mastering embedded system concepts and solutions for automation and robotics.  Mastering operating system concepts for embedded, real-time systems.  Mastering embedded systems software design with the emphasis on real-time operating systems based solutions. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja – teoretične podlage in praktični prikazi na Linuxu.  Laboratorijske vaje, Linux na izbrani vgradni platformi, priprave in praktične programske naloge v jeziku C/C++. | | |  | Lectures, theoretical background with practical demonstrations using Linux.  Laboratory work, selected embedded system platform with Linux, instructions and programming assignments in C/C++. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Opravljene laboratorijske vaje s pisnimi poročili.  Vmesni pisni izpit.  Končni pisni (30) in ustni (10) izpit. | 40%  20%  40% | | | | Laboratory assignment solutions and written reports.  Mid-term written exam.  Final written (30) and oral (10) exam. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. KRISTAN, Matej, SULIĆ KENK, Vildana, KOVAČIČ, Stanislav, PERŠ, Janez. Fast image-based obstacle detection from unmanned surface vehicles. *IEEE transactions on cybernetics*, ISSN 2168-2267, Mar. 2016, vol. 46, no. 3, pp. 641-654. 2. SULIĆ KENK, Vildana, MANDELJC, Rok, KOVAČIČ, Stanislav, KRISTAN, Matej, HAJDINJAK, Melita, PERŠ, Janez. Visual re-identification across large, distributed camera networks. *Image and vision computing*, ISSN 0262-8856, Feb. 2015, vol. 34, pp. 11-26. 3. MUROVEC, Boštjan, PERŠ, Janez, MANDELJC, Rok, SULIĆ KENK, Vildana, KOVAČIČ, Stanislav. Towards commoditized smart-camera design. *Journal of Systems Architecture*, ISSN 1383-7621, Nov. 2013, no. 10, part A, pp. 847-858. 4. SULIĆ, Vildana, PERŠ, Janez, KRISTAN, Matej, KOVAČIČ, Stanislav. Efficient feature distribution for object matching in visual-sensor networks. *IEEE transactions on circuits and systems for video technology*, ISSN 1051-8215, Jul. 2011, vol. 21, no. 7, pp. 903-916. 5. PLACER, Mitja, KOVAČIČ, Stanislav. Enhancing indoor inertial pedestrian navigation using a shoe-worn marker. *Sensors*, ISSN 1424-8220, Aug. 2013, vol. 13, no. 8, pp. 9836-9859. | | | | | |