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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Modul H: Industrijska informatika | | | | | | | | | | | | | | |
| **Course title:** | | | Module H: Industrial Informatics | | | | | | | | | | | | | | |
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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 | | | | | | | | 2 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Control systems and computer engineering | | | | | | | | 2 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni-strokovni /elective professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64319 | | | | | |
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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 |
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| **Nosilec predmeta / Lecturer:** | | | | | Gašper Mušič | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites:** | | | | | | | |
| Vpis v letnik predmeta | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Modeliranje informacijskih, proizvodnih in logističnih sistemov. Zvezni, hibridni in diskretno-dogodkovni modeli. Modelirni jezik UML.  Diskretno-dogodkovna simulacija. Naključne spremenljivke in naključni procesi, sistemi čakalnih vrst. Izvedbe diskretno-dogodkovne simulacije in interpretacija rezultatov. Programska orodja za diskretno-dogodkovno simulacijo. Vizualizacija in animacija v simulaciji. Primeri simulacije proizvodnih in logističnih sistemov.  Kompleksni krmilni sistemi. Programirljivi krmilniki v industrijski avtomatizaciji. Standardi razvoja programske opreme krmilnih sistemov, standardni programski jeziki. Modularni in objektno usmerjeni pristopi, načrtovanje z modeli.  Industrijska komunikacijska omrežja. Področna vodila, industrijski Ethernet. Odprta povezljivost in standardi.  Programska oprema za spremljanje, nadzor in vodenje tehnoloških procesov, sistemi SCADA, programska oprema za zbiranje in analizo podatkov, načrtovanje in izvedba vmesnikov HMI.  Podatkovne baze. Relacijski podatkovni model. Povpraševalni jezik SQL. Modeliranje podatkov. Sistemi za upravljanje podatkovnih zbirk. | | | | | | | |  | | Modelling of information, production and logistic systems. Continuous, hybrid and discrete-event models. Unified modelling language (UML).  Discrete-event simulation. Random variables and random processes, queueing systems. Discrete-event simulation implementation strategies and interpretation of results. Discrete-event simulation software. Visualization in animation in simulation. Production and logistic system simulation examples.  Complex control systems. Programmable controllers in industrial automation. Control software development standards, standard programming languages. Modular and object-oriented approaches, model-based design.  Industrial communication networks. Fieldbus networks, industrial Ethernet. Open connectivity and standards.  Process monitoring, supervision and control software. SCADA systems, data collection and analysis software, HMI design and implementation  Databases. Relational data model. Standard query language (SQL). Data modelling. Database management systems. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. T. Boucher, A. Yalcin, Design of Industrial Information Systems, Academic Press, 2006. 2. T. T. Allen, Introduction to Discrete Event Simulation and Agent-based Modeling, Springer, 2011. 3. R. Zurawski, The Industrial Information Technology Handbook, CRC Press, 2005. 4. K.-H. John, M. Tiegelkamp, IEC 61131-3: Programming Industrial Automation Systems, Second editon, Springer, 2010. 5. S. Strmčnik, R.Hanus, Đ. Juričić, R. Karba, Z. Marinšek, D.Murray-Smith, H. Verbruggen, B. Zupančič, Celostni pristop k računalniškemu vodenju procesov, 1. izdaja, Univerza v Ljubljani, Fakulteta za elektrotehniko, 1998. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Osnove industrijske informatike, predstavitev gradnikov informacijske infrastrukture za spremljanje, nadzor in vodenje tehnoloških procesov.  Načela modeliranja in simulacije informacijskih, proizvodnih in logističnih sistemov.  Razvoj programske opreme kompleksnih krmilnih sistemov, izvedba sistemov za spremljanje in nadzor tehnoloških procesov. | |  | | Basics of industrial informatics, presentation of information infrastructure components for monitoring, supervision and control of technological processes.  Principles of modelling and simulation in the study of information, production and logistic systems.  Development of complex control application software, implementation of process monitoring and supervisory control systems. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Poznavanje gradnikov in metod načrtovanja sistemov industrijske informatike. Ovrednotenje razpoložljivih informacijskih tehnologij glede na potrebe tehnološkega procesa. Sposobnost izbire primernih razvojnih programskih orodij in izdelava aplikativne programske opreme za spremljanje, nadzor in vodenje.  Razumevanje osnov modeliranja in simulacije diskretno-dogodkovnih sistemov. Uporaba orodij za diskretno-dogodkovno simulacijo pri analizi in načrtovanju industrijskih informacijskih sistemov. | | |  | Knowledge of industrial information systems components and related design methods.  Selection of suitable information technologies for a given technological process. Choice of development tools and design of application software for process monitoring, supervision and control.  Understanding of discrete-event modelling and simulation methods. Use of discrete-event simulation software in analysis and design of industrial information systems. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja in laboratorijske vaje. | | |  | Lectures, laboratory exercises. | |
| **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 | 40 %  40 %  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. GRADIŠAR, Dejan, GLAVAN, Miha, STRMČNIK, Stanko, MUŠIČ, Gašper. ProOpter: an advanced platform for production analysis and optimization. *Computers in industry*, ISSN 0166-3615, jun. 2015, vol. 70, str. 102-115, 2. MUŠIČ, Gašper, NAPALKOVA, Liana, PIERA, Miquel Àngel. Performance evaluation of flexible manufacturing systems by coloured timed Petri nets and timed state space generation. V: CAMPOS, Javier (ur.), SEATZU, Carla (ur.), XIE, Xiaolan (ur.). *Formal methods in manufacturing*, (Industrial information technology series). Boca Raton; London; New York: CRC Press, cop. 2014, str. 381-408. 3. GLAVAN, Miha, GRADIŠAR, Dejan, STRMČNIK, Stanko, MUŠIČ, Gašper. Production modelling for holistic production control. Simulation modelling practice and theory, ISSN 1569-190X, jan. 2013, vol. 30, str. 1-20. 4. MUŠIČ, Gašper, MATKO, Drago. An admissible-behaviour-based analysis of the deadlock in Petri-net controllers. Simulation modelling practice and theory, ISSN 1569-190X, Vol. 16, iss. 8 (Sep. 2008), Elsevier, 2008, str. 1077-1090. 5. MUŠIČ, Gašper, GRADIŠAR, Dejan, MATKO, Drago. IEC 61131-3 compliant control code generation from discrete event models. V: *Proceedings of the 2005 IEEE International Symposium on Intelligent Control and 2005 Mediterranean Conference on Control and Automation, 27-29 June2005, Limassol - Cyprus*. Piscataway (New Jersey): The Institute of electrical and electronics engineering: = IEEE, cop. 2005, str. 346-351. | | | | | |