UČNI NAČRT PREDMETA / COURSE SYLLABUS			
Predmet:	Nekonvencionalne platforme in metode procesiranja		
Course title:	Unconventional computing		

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Interdisciplinarni magistrski študijski program Računalništvo in matematika	ni smeri	1 in 2	prvi
Interdisciplinary Masters study programme Computer Science and Mathematics	none	1 in 2	first

Vrsta predmeta / Course type	izbirni
Univerzitetna koda predmeta / University course code:	63512

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
45	**20**	**10**			**105**	**6**

Nosilec predmeta / Lecturer:	Miha Mraz

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovene, angleški/English
	Vaje / Tutorial:	slovenski/Slovene, angleški/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vsebina:	**Content (Syllabus outline):**

Predavanja: I. Platformno pogojene metode procesiranja: a.) Kvantni celularni avtomati (angl. quantum dot cellular automata) b.) Kvantno računalništvo (angl. quantum processing, q.computer) c.) MEMS in NEMS naprave (angl. micro/nano electro mechanical systems) d.) Optično računalništvo (angl. optical computing) e.) DNK procesiranje (angl. DNA computing) f.) Nanocevi (angl. nanotubes) II. Platformno neodvisne metode procesiranja: a.) Amorfno procesiranje (angl. amorphous computing) b.) Reverzibilno procesiranje (angl. reversible computing) c.) Večstanjsko in analogno procesiranje (angl. multistate and analogous computing) d.) Naravno inspirirano procesiranje (angl. bio inspired computing)		Basic topics: I. Unconventional processing platforms: quantum dot cellular automata, quantum computing, MEMS/NEMS devices, Optical computing DNA processing, nanotubes, etc. II. Unconventional processing approaches: amorphous computing, reversible computing, multistate and analogous computing, bio inspired computing, etc.

Temeljni literatura in viri / Readings:

1. M.Mraz: Iskanje procesne platforme prihodnosti. https://ucilnica.fri.uni-lj.si/course/view.php?id=91. (e-book, 2017)

2. F.Lombardi, J.Huang: Design and test of digital circuits by quantum-dot cellular automata, Artech House Inc., 2008

3. U.Alon: An introduction to systems biology : design principles of biological circuits, Chapman &, Hall / CRC, 2007

Cilji in kompetence: **Objectives and competences:**

Cilj predmeta je študentom predstaviti nekatere najbolj aktualne metode in platforme procesiranja z vidika bazičnih sestavnih struktur, ki se danes uveljavljajo kot možne alternative klasičnim električno tranzistorskim dvovrednostnim logičnim strukturam. Razvoj slednjih bo drastično upočasnjen zaradi problemov tendenc miniaturizacije, saj jim bo tehnologija s svojimi rešitvami vse težje sledila. Ostale kompetence: Zmožnost definiranja, razumevanja in reševanja profesionalnih izzivov Zmožnost iskanja novih virov znanj in njihova kritična evaluacija	The main goal of the course is to present recent unconventional methods and platforms for computer processing needs. The motivation for the course comes from the restrictions in the field of minimization of classical computer structures. Other competences: The ability to define, understand and solve creative professional challenges in computer and information science, The ability to search knowledge sources and to search for resources and critically evaluate information.
Predvideni študijski rezultati:	**Intended learning outcomes:**
Po uspešnem zaključku tega predmeta bo študent: sposoben kritične analitične obravnave načina delovanja obstoječih platform in metod procesiranja, razumel koncept reverzibilnosti logičnih funkcij, poznal in znal uporabljati koncepte porazdeljenih sistemov celularnih avtomatov in kvantnih celularnih avtomatov, razumel in znal uporabljati koncepte večvrednostnih logik in procesiranja, razumel koncepte biološkega procesiranja, razumel koncepte kvantnega procesiranja, sposoben obravnave in reševanja problema na osnovi alternativnih metod procesiranja.	After the completion of the course a student: - will be able to objectively analyse the existing processing platforms and methods, - will be able to understand the concept of logic functions reversibility, - will be familiar with the concepts of distributed systems, such as cellular automata and quantum-dot cellular automata, - will understand and will be able to apply the concepts of a many-valued logic and processing in practice, - will understand the concepts of biological computing, - will understand the concepts of quantum computing, - will be able to solve problems on the basis of alternative processing methods.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, praktične vaje s seminarji vsebinsko vezane na izvajanje eksperimentov, postavitve modelov, itd.	Lectures, practical lessons with seminar works, etc.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji, projektno in seminarsko delo) Končno preverjanje (pisni izpit) Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).	50% 50%	Type (examination, oral, coursework, project): Continuing (homework, midterm exams, project work or seminar paper) Final (written exam) Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Miha Mraz:

– LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. The ternary quantum-dot cell and ternary logic. Nanotechnology, ISSN 0957-4484, 2006, vol. 17, no. 8, str. 1937-1942, ilustr [COBISS.SI-ID 5201748]

– LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. Towards the bottom-up concept : extended quantum-dot cellular automata. Microelectronic engineering, ISSN 0167-9317. [Print ed.], 2006, vol. 83, no. 4/9, str. 1826-1829, ilustr [COBISS.SI-ID 5212244]

– PEČAR, Primož, MRAZ, Miha, ZIMIC, Nikolaj, JANEŽ, Miha, LEBAR BAJEC, Iztok. Solving the ternary quantum-dot cellular automata logic gate problem by means of adiabatic switching. Japanese journal of applied physics, ISSN 0021-4922, 2008, vol. 47, no. 6, str. 5000-5006, ilustr [COBISS.SI-ID 6537044]

– PEČAR, Primož, RAMŠAK, Anton, ZIMIC, Nikolaj, MRAZ, Miha, LEBAR BAJEC, Iztok. Adiabatic pipelining : a key to ternary computing with quantum dots. Nanotechnology, ISSN 0957-4484,

2008, vol. 19, no. 49, str. 1-12, ilustr [COBISS.SI-ID 6790228]

– MOŠKON, Miha, AVBELJ, Monika, ZIMIC, Nikolaj, MRAZ, Miha. Toward in vivo digital synchronous sequential circuits. WSEAS Transactions on Circuits, ISSN 1109-2734, Mar. 2009, vol. 8, no. 3, str. 301-310, ilustr [COBISS.SI-ID 7111764]