UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Sočasno načrtovanje strojne in programske opreme
Course title:	Hardware/Software Codesign

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 2. stopnja	Računalniške strukture in sistemi	1	2
Information and Communication Technologies, 2nd cycle	Computer Structures and Systems	1	2

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT2-697

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
15	15			15	105	5

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Gregor Papa

Jeziki / Languages:		
	Predavanja / Lectures:	slovenščina, angleščina / Slovenian, English
	Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zaključen študijski program prve stopnje s področja naravoslovja, tehnike ali računalništva.	Student must complete first-cycle study programmes in natural sciences, technical disciplines or computer science.

Vsebina:	**Content (Syllabus outline):**
Pregled sočasnega načrtovanja: Kaj je sočasno načrtovanje ter zakaj je potrebno in pomembno. Ciljne arhitekture: Vgradni sistemi; splošno namenski procesorji, DSP, namenska vezja, FPGA, SoC. Metode sočasnega načrtovanja: Različni nivoji predstavitve modela; razdeljevanje strojnega in programskega dela; razvrščanje operacij in dodeljevanje gradnikov; upoštevanje nasprotujočih si omejitev; optimiranje programske kode. Ocenjevanje: Strojna, programska in celovita ustreznost sistema.	Codesign Overview: What is codesign – why is it necessary and important Target Architectures: Embedded systems; general purpose processors, DSP, ASIC, FPGA, SoC. Codesign Methodologies: Different levels of model representation; hardware and software partitioning; operation scheduling and resource allocation; dealing with contradictory constraints; software code optimizations. Estimation: Hardware, software and system as a whole suitability.

Temeljna literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- P.R. Schaumont, *A Practical Introduction to Hardware/Software Codesign*. Springer, 2013, ISBN: 978-1-4614-3736-9
- M. Wolf, *Computers as Components*. Academic Press, 2012. ISBN 978-0123884367
- P. Marwedel, *Embedded System Design*. Springer, 2011. ISBN: 978-94-007-0257-8
- G. DeMicheli, R. Ernst, and W. Wolf, *Readings in Hardware/Software Co-design*. Morgan Kaufmann, 2001. ISBN: 978-1-55860-702-6
- G. DeMicheli, *Synthesis and Optimization of Digital Circuits*. McGraw-Hill, Inc., 1994, ISBN: 978-0070163331

Cilji in kompetence:

Cilj predmeta je študentom posredovati teoretično in praktično znanje o sočasnem načrtovanju strojne in programske opreme. Uvodoma so predstavljeni osnovni strojni gradniki (procesorji, namenska vezja, programirljiva vezja), osnove programske opreme (način pisanja, sekvenčno in vzporedno izvajanje) ter njun medsebojni vpliv. Študij sočasnega načrtovanja se osredotoča na povezavo in soodvisnost med strojno in programsko opremo.

Slušatelji pridobijo osnovno teoretično razumevanje in praktične izkušnje s področja sočasnega načrtovanja strojne in programske opreme. Tovrstno znanje bo omogočilo uporabo znanstvenih metod za reševanje zahtevnih znanstveno-raziskovalnih nalog ter vodenja razvojnih in raziskovalnih programov s ciljem modernizacije in povečanja proizvodnje skozi učinkovite vgrajene aplikacije.

Objectives and competences:

The goal of this course is to provide to the students the theoretical and practical knowledge on hardware and software codesign. The course introduces the major hardware structures (processors, application-specific circuits, programmable gate arrays), basics on software approaches (description type, sequential and parallel execution), and their mutual influence. The study of hardware/software codesign focuses on the close link-up and mutual influence between hardware and software.

The student will gain the basic theoretical understanding and practical experiences in the field of hardware/software codesign. Gained knowledge will allow the use of scientific methods for solving of complex scientific-research tasks, and guidance of development and research programs, with the goal of modernization and production growth through the efficient embedded applications.

Predvideni študijski rezultati:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili:

- sposobnost analize, sinteze in predvidevanja rešitev ter posledic,
- sposobnost uporabe znanja v praksi,
- avtonomnost v strokovnem delu,
- sposobnost izbrati ustrezno razmerje strojne in programske opreme ter ju povezati v učinkovit celovit sistem,
- sposobnost optimizirati programsko opremo ob upoštevanju izbrane strojne opreme,
- sposobnost integrirati znanja z različnih področij pri reševanju specifičnih realnih problemov.

Intended learning outcomes:

Students successfully completing this course will acquire:

- An ability to analyse, synthesise and anticipate solutions and consequences;
- An ability to apply the theory in to a practice;
- An autonomy in the professional work;
- An ability to select suitable hardware and software and connect them into the efficient system;
- An ability to optimize the software regarding the selected hardware;
- An ability to integrate the knowledge from different fields to solve specific real-world problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar, konzultacije, individualno delo	Lectures, seminar, consultancy, individual work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminarska naloga	50 %	Seminar work
Ustni zagovor seminarske naloge	50 %	Oral defense of seminar work

Reference nosilca / Lecturer's references:

- **G. Papa**, "Parameter-less algorithm for evolutionary-based optimization: for continuous and combinatorial problems," *Computational Optimization and Applications,* vol. 56, no. 1, pp. 209-229, 2013.
- **G. Papa**, and P. Mrak, "Temperature simulations in cooling appliances," *Elektrotehniški vestnik*, vol. 78, no. 1, pp. 67-72, 2011.
- T. Garbolino, and **G. Papa**, "Genetic algorithm for test pattern generator design, Automatic evolution of circuits," *Applied Intelligence*, vol. 32, no. 2, pp. 193-204, 2010.
- **G. Papa**, and D. Torkar, "Visual control of an industrial robot manipulator: accuracy estimation," *Journal of Mechanical Engineering*, vol. 55, no. 12, pp. 781-787, 2009.
- G. Klajnšek, B. Žalik, F. Novak, and **G. Papa**, "A quadtree-based progressive lossless compression technique for volumetric data sets," *Journal of Information Science and Engineering*, vol. 24, no. 4, pp. 1187-1195, 2008.