UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Večkriterijsko optimiranje in načrtovanje
Course title:	Multiobjective Optimization and Design

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 3. stopnja	Tehnologije znanja	1	1
Information and Communication Technologies, 3rd cycle	Knowledge Technologies	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT3-715

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	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. Bogdan Filipič

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zaključen študij druge stopnje s področja informacijskih ali komunikacijskih tehnologij ali zaključen študij druge stopnje na drugih področjih z znanjem osnov s področja predmeta. Potrebna so tudi osnovna znanja matematike, računalništva in informatike.	Completed second cycle studies in information or communication technologies or completed second cycle studies in other fields with knowledge of fundamentals in the field of this course. Basic knowledge of mathematics, computer science and informatics is also requested.

Vsebina:	**Content (Syllabus outline):**
Uvod: večkriterijski optimizacijski problemi, domininanost rešitev in Pareto optimalnost, prednostni in idealni način reševanja problemov večkriterijske optimizacije in načrtovanja Tradicionalne metode: utežena vsota kriterijev, prevedba kriterijev v omejitve, metoda epsilon omejitev Populacijske metode: evolucijski algoritmi za večkriterijsko optimiranje, algoritem NSGA-II, algoritem DEMO, drugi populacijski algoritmi Vrednotenje rezultatov:	Introduction: multiobjective optimization problems, solution dominance and Pareto optimality, preference-based and ideal approaches to multiobjective optimization and design problems Traditional methods: weighted sum of objectives, transformation of objectives into constraints, epsilon constraint method Population-based methods: evolutionary multiobjective optimization algorithms, NSGA-II algorithm, DEMO algorithm, other population algorithms

statistična analiza, hipervolumen, površina dosega, Pareto-skladne mere Študije primerov: večkriterijska optimizacija in načrtovanje v znanosti, tehniki in poslovnih sistemih	Evaluation of results: statistical analysis, hypervolume, attainment surface, Pareto-compliant metrics Case studies: multiobjective optimization and design in science, engineering and business

Temeljna literatura in viri / Readings:

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

- V. Barichard, X. Gandibleux, and v. T'Kindt, Eds. *Multiobjective Programming and Goal Programming*. Springer, 2009. ISBN 978-3-540-85645-0
- J. Branke, K. Deb, K., Miettinen, and R. Slowinski, Eds. *Multiobjective Optimization: Interactive and Evolutionary Approaches*. Springer, 2008. ISBN 978-3-540-88907-6
- A. E. Eiben, and J. E. Smith, *Introduction to Evolutionary Computing*, 2nd edition. Springer, 2015. ISBN 978-3-662-44873-1
- C.-K. Goh, and K. C. Tan, *Evolutionary Multi-objective Optimization in Uncertain Environments*. Springer, 2009. ISBN 978-3-540-95975-5
- L. Wang, A. H. C. Ng, and K. Deb, Kalyanmoy, Eds. *Multi-objective Evolutionary Optimisation for Product Design and Manufacturing*. Springer, 2011. ISBN978-0-85729-617-7

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta so (a) predstaviti osnove večkriterijske optimizacije in načrtovanja ter matematične koncepte, potrebne za formuliranje in reševanje tovrstnih problemov, (b) predstaviti tradicionalne in populacijske metode večkriterijskega optimiranja, (c) predstaviti metodologijo vrednotenja rezultatov, (d) prikazati uporabnost metod na primerih uporabe iz prakse. Študenti, ki bodo uspešno končali ta predmet, bodo obvladali osnove večkriterijskega optimiranja in načrtovanja in bodo usposobljeni za uporabo predstavljene metodologije pri formuliranju in reševanju problemov s tega področja ter vrednotenje rezultatov.	The course objectives are to (a) introduce the basics of multiobjective optimization and design, and the mathematical concepts needed to formulate and solve the problems of this type, (b) present the traditional and population-based methods of multiobjective optimization, (c) present the methodology of result evaluation, (d) demonstrate the application potential of the methods on use cases from practice. The students who will successfully complete this course will master the basics of multiobjective optimization and design, and will be capable of applying the presented methodology in formulating and solving the problems from this field and evaluating the results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili: • razumevanje konceptov večkriterijskega optimiranja in načrtovanja, • obvladovanje izbranih metod in algoritmov, • usposobljenost za njihovo uporabo v reševanju praktičnih problemov, • usposobljenost za interpretacijo in vrednotenje rezultatov.	Students successfully completing this course will acquire: • understanding the concepts of multiobjective optimization and design, • mastering the selected methods and algorithms, • ability to apply them in practical problem solving, • ability to interpret and evaluate their results.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Pisni ali ustni izpit	100 %	Written or oral exam

Reference nosilca / Lecturer's references:

- T. Tušar, and **B. Filipič**. "Visualization of Pareto front approximations in evolutionary multiobjective optimization: A critical review and the prosection method." *IEEE Transactions on Evolutionary Computation*, vol. 19, no. 2, pp. 225-245, 2015.
- M. Mlakar, D. Petelin, T. Tušar, and **B. Filipič**. "GP-DEMO: Differential evolution for multiobjective optimization based on Gaussian process models." *European Journal of Operational Research*, vol. 243, no. 2, pp. 347-361, 2015.
- E. Dovgan, M. Javorski, T. Tušar, M. Gams, and **B. Filipič**. "Discovering driving strategies with a multiobjective optimization algorithm." *Applied Soft Computing*, vol. 16, no. 1, pp. 50-62, 2014.
- M. Depolli, R. Trobec, and **B. Filipič**. "Asynchronous master-slave parallelization of differential evolution for multiobjective optimization." *Evolutionary Computation*, vol. 21, no. 2, pp. 261-291, 2013.
- P. Korošec, J. Šilc, and **B. Filipič**. "The differential ant-stigmergy algorithm." *Information Sciences*, vol. 192, no. 1, pp. 82-97, 2012.