UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Simbolno računanje
Course title:	Symbolic computation

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 ali 2	prvi ali drugi
Interdisciplinary Masters study programme Computer Science and Mathematics	none	1 or 2	first or second

Vrsta predmeta / Course type	izbirni
Univerzitetna koda predmeta / University course code:	M2832

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
30	**15**	**30**			**105**	**6**

Nosilec predmeta / Lecturer:	prof. Marko Petkovšek

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):**

1. Prepisovalni sistemi (redukcijske relacije, Newmanova lema, problem napolnitve) 2. Operacije s polinomi (rezultante in podrezultante, modularna aritmetika, Henslov dvig, razcep in razstavljanje polinomov) 3. Operacije z ideali (monomske urejenosti, Gröbnerjeve baze, reševanje sistemov algebraičnih enačb, uporaba v geometriji in robotiki) 4. Reševanje linearnih diferenčnih in diferencialnih enačb (polinomske rešitve, hipergeometrične in hipereksponentne rešitve, seštevanje in integriranje v zaključeni obliki, avtomatsko dokazovanje identitet)	1. Rewrite systems (reduction relations, Newman's lemma, completion) 2. Operations with polynomials (resultants and subresultants, modular arithmetic, Hensel lifting, polynomial factorization and decomposition) 3. Operations with ideals (monomial orders, Gröbner bases, solving systems of algebraic equations, applications in geometry and robotics) 4. Solving linear difference and differential equations (polynomial solutions, hypergeometric and hyperexponential solutions, summation and integration in closed form, automated proofs of identities)

Temeljni literatura in viri / Readings:

David Cox, John Little, Donal O'Shea: Ideals, Varieties, and Algorithms. Third edition. Springer, New York , 2007. ISBN: 978-0-387-35650-1.

Joachim von zur Gathen, Jürgen Gerhard: Modern Computer Algebra. Third edition. Cambridge University Press, Cambridge, 2013. ISBN: 978-1-107-03903-2.

The Concrete Tetrahedron. Symbolic Sums, Recurrence Equations, Generating Functions, Asymptotic Estimates. Texts and Monographs in Symbolic Computation. Springer, Dunaj, 2011. ISBN: 978-3-7091-0444-6

Cilji in kompetence:	**Objectives and competences:**
Študent pridobi sposobnost uporabe orodij za avtomatično reševanje matematičnih problemov, pomembnih v uporabi, kot so problem predstavitve algebraičnih struktur, problem poenostavljanja izrazov, reševanje sistemov algebraičnih enačb, reševanje linearnih diferenčnih in diferencialnih enačb ter seštevanje in integriranje v zaključeni obliki.	Students acquire competency to use tools for automated solving of mathematical problems, important in applications, such as the problem of representation of algebraic structures, the problem of simplification of expressions, solving systems of algebraic equations, solving linear difference and differential equations, and summation and integration in closed form.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Polni prepisovalni sistemi. Delovanje algoritmov za razcep in razstavljanje polinomov. Algoritmi za reševanje sistemov algebraičnih enačb. Algoritmi za reševanje linearnih diferenčnih in diferencialnih enačb. Algoritmi za seštevanje in integriranje v zaključeni obliki ter za avtomatično dokazovanje identitet.	Knowledge and understanding: Complete rewrite systems. Operation of algorithms for polynomial factorization and decomposition. Algorithms for solving systems of algebraic equations. Algorithms for solving linear difference and differential equations. Algorithms for closed-form summation and integration and for proving identities.

Uporaba: Reševanje problemov v robotiki, geometriji, kombinatoriki in analizi zahtevnosti algoritmov. Refleksija: Povezave med problemi predstavitve, poenostavitve in računanja. Prenosljive spretnosti – niso vezane le na en predmet: Spretnost uporabe računalnika pri eksaktnem reševanju nekaterih matematičnih problemov.	Application: Solving problems in robotics, geometry, combinatorics, and analysis of complexity of algorithms. Reflection: Relations among problems of representation, simplification, and computation. Transferable skills: The ability to solve certain mathematical problems exactly by means of a computer.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, domace naloge, konzultacije, projekti.	Lectures, exercises, homeworks, consultations, projects.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (domače naloge, pisni izpit, ustno izpraševanje, naloge, projekt): domače naloge ali projekt pisni izpit ustni izpit Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	 20% 40% 40%	Type (homeworks, examination, oral, coursework, project): homeworks or project written exam oral exam Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Marko Petkovšek:

– PETKOVŠEK, Marko, WILF, Herbert S., ZEILBERGER, Doron. A=B. Wellesley (Massachusetts): A. K. Peters, cop. 1996. VII, 212 str. ISBN 1-56881-063-6 [COBISS.SI-ID 4085337]

– BOUSQUET-MÉLOU, Mireille, PETKOVŠEK, Marko. Linear recurrences with constant coefficients:

the multivariate case. Discrete Mathematics, ISSN 0012-365X. [Print ed.], 2000, vol. 225, no. 1-3, str. 51-75 [COBISS.SI-ID 10147929]

– PETKOVŠEK, Marko, ZAKRAJŠEK, Helena. Solving linear recurrence equations with polynomial coefficients. V: SCHNEIDER, Carsten (ur.), BLÜMLEIN, Johannes (ur.). Computer algebra in quantum field theory : integration, summation and special functions, (Texts and monographs in symbolic computation, ISSN 0943-853X). Wien: Springer, cop. 2013, str. 259-284 [COBISS.SI-ID 16779353]