

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
<b>Predmet:</b>		Izbrana poglavja iz numerične matematike				
<b>Course title:</b>		Topics in numerical mathematics				
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year	<b>Semester</b> 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	
<b>Vrsta predmeta / Course type</b>				izbirni		
<b>Univerzitetna koda predmeta / University course code:</b>				M2829		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike študija</b>	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
30	15	30			105	6
<b>Nosilec predmeta / Lecturer:</b>			prof. Bor Plestenjak, prof. Emil Žagar, prof. Gašper Jaklič, prof. Marjetka Knez			
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b>		slovenski/Slovene, angleški/English		
		<b>Vaje / Tutorial:</b>		slovenski/Slovene, angleški/English		
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>		
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>		

<p>Predavatelj izbere nekatere pomembne teme s področja numerične matematike, kot so na primer:</p> <p>Numerična aproksimacija in interpolacija.</p> <p>Numerična integracija in navadne diferencialne enačbe.</p> <p>Numerično reševanje parcialnih diferencialnih enačb.</p> <p>Subdivizijske sheme.</p> <p>Krivulje s pitagorejskim hodografom.</p> <p>Metoda končnih elementov.</p> <p>Računanje z matrikami pri rudarjenju podatkov in razpoznavanju vzorcev.</p> <p>Numerične metode za linearne sisteme upravljanja.</p> <p>Iterativne numerične metode v linearni algebri.</p>	<p>The lecturer chooses some important topics from numerical mathematics, e.g.:</p> <p>Numerical approximation and interpolation</p> <p>Numerical integration and ordinary differential equations.</p> <p>Numerical solving of partial differential equations.</p> <p>Subdivision schemes.</p> <p>Pythagorean-hodograph curves.</p> <p>Matrix methods in data mining and pattern recognition.</p> <p>Finite elements method.</p> <p>Numerical methods for linear control systems.</p> <p>Iterative numerical methods in linear algebra.</p>
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### Temeljni literatura in viri / Readings:

J. Kozak: Numerična analiza, DMFA-založništvo, Ljubljana, 2008.

R. L. Burden in J. D. Faires: Numerical Analysis, 8th edition, Brooks/Cole, Pacific Grove, 2005.

N. Dyn: Subdivision Schemes in Computer-Aided Geometric Design, Advances in Numerical Analysis II Wavelets, Subdivision Algorithms and Radial Basis Functions, W. Light (ed.), Clarendon Press, Oxford, 36-104 (1992).

R. T. Farouki: Pythagorean-Hodograph Curves: Algebra and Geometry Inseparable, Geometry and Computing, vol. 1, Springer, Berlin, 2008.

J. N. Reddy: An introduction to finite elements method, McGraw-Hill, 1993.

L. Elden: Matrix Methods in Data Mining and Pattern Recognition, SIAM, Philadelphia, 2007.

B. N. Datta: Numerical Methods for Linear Control Systems, Academic Press, San Diego, 2004.

R. Barrett, M. W. Berry, T. F. Chan, J. Demmel, J. Donato, J. Dongarra, V. Eijkhout, R. Pozo, C. Romine, H. van der Vorst: Templates for the Solution of Linear Systems : Building Blocks for Iterative Methods, SIAM, Philadelphia, 1994.

Z. Bai, J. Demmel, J. Dongarra, A. Ruhe, H. van der Vorst: Templates for the Solution of Algebraic Eigenvalue Problems : A Practical Guide, SIAM, Philadelphia, 2000.

#### **Cilji in kompetence:**

Študent podrobneje spozna eno ali več pomembnejših področij numerične matematike. Pri tem spozna nekatere najnovejše rezultate z obravnavanega področja.

#### **Objectives and competences:**

The student sees the details of one or more important areas of numerical mathematics, and learns about some recent results in the subjects.

#### **Predvideni študijski rezultati:**

Znanje in razumevanje: Poglobljeno znanje na enem ali več področjih numerične matematike in je sposobnost reševati probleme, ki so v praksi vezani na širše znanje s tega področja. Znanje programiranja in uporabe računalniških orodij za reševanje tovrstnih problemov. Uporaba: Numerično reševanje matematičnih problemov. Refleksija: Razumevanje teorije na podlagi uporabe. Prenosljive spretnosti – niso vezane le na en predmet: Spretnost uporabe računalnika pri reševanju matematičnih problemov.

#### **Intended learning outcomes:**

Knowledge and understanding:  
A deeper knowledge of one or several topics in numerical mathematics and capability of solving practical problems somehow connected with selected subjects. Knowledge of programming and usage of computer software for solving such problems.  
Application: Numerical computation of mathematical problems.

	<p>Reflection: Understanding of the theory from the applications.</p> <p>Transferable skills: The ability to solve mathematical problems using a computer.</p>

**Metode poučevanja in učenja:**

Predavanja, vaje, domače naloge, seminar, projekti in konsultacije.

**Learning and teaching methods:**

Lectures, tutorials, homeworks, seminar, projects and consultation.

Delež (v %) /

**Načini ocenjevanja:**

Weight (in %)

**Assessment:**

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p> <p>Sprotno preverjanje (domače naloge, kolokviji in projektno delo)</p> <p>Končno preverjanje (pisni in ustni izpit)</p> <p>Ocene: 6-10 pozitivno, 5 negativno</p> <p>(v skladu s Statutom UL)</p>	<p>50%</p> <p>50%</p>	<p>Type (examination, oral, coursework, project):Continuing (homework, midterm exams, project work)Final (written and oral exam)</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana)</p>
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**Reference nosilca / Lecturer's references:**

Gašper Jaklič:  
 – JAKLIČ, Gašper. On the dimension of bivariate spline space  $S_{[3]^{[1]}}$  ([triangle]).  
 International journal of computer mathematics, ISSN 0020-7160, 2005, vol. 82, no. 11, str. 1355-

1369 [COBISS.SI-ID 13801305]

– JAKLIČ, Gašper, ŽAGAR, Emil. Planar cubic G [sup] 1 interpolatory splines with small strain energy. *Journal of Computational and Applied Mathematics*, ISSN 0377-0427. [Print ed.], 2011, vol. 235, iss. 8, str. 2758-2765 [COBISS.SI-ID 15770969]

– JAKLIČ, Gašper, ŽAGAR, Emil. Curvature variation minimizing cubic Hermite interpolants. *Applied mathematics and computation*, ISSN 0096-3003. [Print ed.], 2011, vol. 218, iss. 7, str. 3918-3924 [COBISS.SI-ID 16049241]

Marjetka Knez:

– KRAJNC, Marjetka. Geometric Hermite interpolation by cubic G[<sup>sup</sup>]1 splines. *Nonlinear Analysis, Theory, Methods and Applications*, ISSN 0362-546X. [Print ed.], 2009, vol. 70, iss. 7, str. 2614-2626 [COBISS.SI-ID 15508569]

– KRAJNC, Marjetka. Interpolation scheme for planar cubic G [sup] 2 spline curves. *Acta applicandae mathematicae*, ISSN 0167-8019, 2011, vol. 113, no. 2, str. 129-143 [COBISS.SI-ID 16215385]

– JAKLIČ, Gašper, KOZAK, Jernej, KRAJNC, Marjetka, VITRIH, Vito, ŽAGAR, Emil. High order parametric polynomial approximation of conic sections. *Constructive approximation*, ISSN 0176-4276, 2013, vol. 38, iss. 1, str. 1-18 [COBISS.SI-ID 16716121]

Bor Plestenjak:

– HOCHSTENBACH, Michiel E., KOŠIR, Tomaž, PLESTENJAK, Bor. A Jacobi-Davidson type method for the two-parameter eigenvalue problem. *SIAM journal on matrix analysis and applications*, ISSN 0895-4798, 2005, vol. 26, no. 2, str. 477-497 [COBISS.SI-ID 13613401]

– PLESTENJAK, Bor. Numerical methods for the tridiagonal hyperbolic quadratic eigenvalue problem. V: *Fifth international workshop on accurate solution in eigenvalue problems : hagen, Germany from June 29 to July 1, 2004*. Philadelphia: SIAM, 2006, vol. 28, no. 4, str. 1157-1172 [COBISS.SI-ID 14367833]

– HOCHSTENBACH, Michiel E., MUHIČ, Andrej, PLESTENJAK, Bor. On linearizations of the quadratic two-parameter eigenvalue problem. *Linear Algebra and its Applications*, ISSN 0024-3795. [Print ed.], 2012, vol. 436, iss. 8, str. 2725-2743 [COBISS.SI-ID 16095065]

Emil Žagar:

– ŽAGAR, Emil. On G [sup] 2 continuous spline interpolation of curves in  $R$  [sup]  $d$ . *BIT*, ISSN 0006-3835, 2002, vol. 42, no. 3, str. 670-688 [COBISS.SI-ID 12027993]

– KOZAK, Jernej, ŽAGAR, Emil. On geometric interpolation by polynomial curves. *SIAM journal on*

numerical analysis, ISSN 0036-1429, 2004, vol. 42, no. 3, str. 953-967 [COBISS.SI-ID 13398617]

– JAKLIČ, Gašper, KOZAK, Jernej, VITRIH, Vito, ŽAGAR, Emil. Lagrange geometric interpolation by rational spatial cubic Bézier curves. Computer Aided Geometric Design, ISSN 0167-8396, 2012, vol. 29, iss. 3-4, str. 175-188 [COBISS.SI-ID 16207449]