

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
Predmet:		Uvod v numerične metode				
Course title:		Introduction to numerical methods				
Študijski program in stopnja Study programme and level		Študijska smer Study field		Letnik Academic year	Semester Semester	
Enoviti magistrski študijski program Pedagoška matematika		ni smeri		3	prvi	
Integrated Master's study programme Pedagogical Mathematics		none		3	first	
Vrsta predmeta / Course type				obvezni		
Univerzitetna koda predmeta / University course code:				M0519		
Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		45			90	6
Nosilec predmeta / Lecturer:		prof. Bor Plestenjak, prof. Emil Žagar				
Jeziki / Languages:		Predavanja / Lectures:		slovenski/Slovene		
		Vaje / Tutorial:		slovenski/Slovene		
Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:				Prerequisites:		
Vsebina:				Content (Syllabus outline):		

<p>Uvod v numerično računanje. Premična aritmetika, model IEEE. Izvori napak pri numeričnem računanju. Občutljivost problemov, konvergenca metod in stabilnost računskih procesov. Ocena za celotno napako. Programska oprema za numerično računanje.</p> <p>Sistemi linearnih enačb. Matrične norme. Občutljivost. Ocena za napako. Gaussova metoda. Analiza zaokrožitvenih napak. Pivotiranje. Posebni linearni sistemi.</p> <p>Nelinearne enačbe. Bisekcija. Splošna iteracija. Tangentna in sekantna metoda. Algebraične enačbe. Laguerrova metoda. Redukcija korenov. Sistemi nelinearnih enačb. Splošna iteracija. Newtonova metoda.</p> <p>Linearni problem najmanjših kvadratov. Predoločeni sistemi. Normalni sistem. Ortogonalni razcep. Givensove rotacije in Householderjeve transformacije.</p> <p>Problem lastnih vrednosti. Schurova forma. Potenčna metoda. Inverzna potenčna metoda. QR-iteracija.</p> <p>Interpolacija s polinomi. Lagrangeeva oblika interpolacijskega polinoma. Deljene difference. Newtonova oblika interpolacijskega polinoma. Numerično odvajanje.</p> <p>Numerično integriranje. Newton-Cotesova pravila. Sestavljena pravila. Rombergova ekstrapolacija. Gaussova kvadratura pravila.</p> <p>Numerično reševanje navadnih diferencialnih enačb. Metode za reševanje enačb prvega reda. Enočlenske metode. Metode tipa Runge-Kutta. Sistemi diferencialnih enačb in začetni problemi višjega reda.</p>	<p>Introduction to numerical computation. Floating-point arithmetic, IEEE standard. Sources of inexactness in numerical computation. Sensitivity of a problem, convergence of a method, stability of computation. Error analysis. Software for numerical computation.</p> <p>Systems of linear equations. Matrix norms and condition numbers. Error bounds. Gaussian elimination. Error analysis. Pivoting. Special types of linear systems.</p> <p>Nonlinear equations. Bisection. Fixed-point iteration. Newton's and Secant method. Algebraic equations. Laguerre's method, Root reduction. System of nonlinear equations.</p> <p>Linear least square problems. Overdetermined systems. Normal equations. Orthogonal decomposition. Givens rotations and Householder transformations.</p> <p>Eigenvalue problems. Schur form. Power iteration. Inverse iteration. QR iteration.</p> <p>Polynomial interpolation. Lagrange interpolation. Divided differences. Newton form. Numerical differentiation.</p> <p>Numerical integration. Newton-Cotes rules. Composite rules. Romberg extrapolation. Gaussian quadrature.</p> <p>Numerical methods for ordinary differential equations. Methods for initial value problems. One-step methods. Runge-Kutta methods. Systems of differential equations and initial problems of higher order.</p>
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Temeljni literatura in viri / Readings:

J. W. Demmel: Uporabna numerična linearna algebra, DMFA-založništvo, Ljubljana, 2000.

Z. Bohte: Numerične metode, DMFA-založništvo, Ljubljana, 1991.

Z. Bohte: Numerično reševanje nelinearnih enačb, DMFA-založništvo, Ljubljana, 1993.

Z. Bohte: Numerično reševanje sistemov linearnih enačb, DMFA-založništvo, Ljubljana, 1994.

G. H. Golub, C. F. Van Loan: Matrix Computations, 3rd edition, Johns Hopkins Univ. Press, Baltimore, 1996.

B. N. Datta: Numerical Linear Algebra and Applications, Brooks/Cole, Pacific Grove, 1995.

L. N. Trefethen, D. Bau: Numerical Linear Algebra, SIAM, Philadelphia, 1997.

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

D. R. Kincaid, E. W. Cheney: Numerical Analysis : Mathematics of Scientific Computing, 3rd edition, Brooks/Cole, Pacific Grove, 2002.

Cilji in kompetence:

Slušatelj spozna osnove numeričnega računanja. Podrobneje spozna računanje s plavajočo vejico ter reševanje linearnih in nelinearnih sistemov. V grobem spozna osnovne metode za računanje lastnih vrednosti, za interpolacijo, numerično integriranje in reševanje navadnih diferencialnih enačb. Pridobljeno znanje praktično utrdi z domačimi nalogami in reševanjem problemov s pomočjo programov za numerično računanje.

Objectives and competences:

Students learn fundamentals of numerical computation. They learn in detail the fixed-point arithmetic and methods for system of linear and nonlinear equations. They learn basics of eigenvalue computation, polynomial interpolation, numerical quadrature, and methods for the ordinary differential problems. The acquired knowledge is consolidated by homework assignments and solving problems using software for numerical computation.

Predvideni študijski rezultati:

Znanje in razumevanje: Razumevanje računanja s plavajočo vejico in izvorov napak pri numeričnem računanju. Obvladanje osnovnih algoritmov za reševanje linearnih in nelinearnih sistemov. Poznavanje osnovnih numeričnih algoritmov za računanje lastnih vrednosti, interpolacijo, integriranje, in reševanje diferencialnih enačb. Znanje programiranja in uporabe Matlaba oziroma drugih sorodnih orodij za reševanje tovrstnih problemov. Uporaba: Ekonomično in natančno

Intended learning outcomes:

Knowledge and understanding: Understanding of floating-point arithmetic and sources of errors in numerical computation. Proficiency in basic numerical methods for linear and nonlinear systems. Knowledge of basic numerical algorithms for computing eigenvalues, interpolation, integration, and solving differential equations. Knowledge of computer programming and Matlab or other similar software for solving such problems. Applications: Economical and accurate

<p>numerično reševanje različnih matematičnih problemov. Poleg matematike se uporablja še v številnih prostalih področjih, vsakič ko se da problem opisati z matematičnim modelom in se išče rezultat v numerični obliki. Številnih problemov ni mogoče rešiti analitično, temveč le numerično, v nekaterih primerih pa je numerično reševanje mnogo bolj ekonomično od analitičnega.</p> <p>Refleksija: Razumevanje teorije na podlagi uporabe.</p> <p>Prenosljive spretnosti – niso vezane le na en predmet: Spretnost uporabe računalnika pri reševanju matematičnih problemov. Razumevanje razlik med eksaktnim in numeričnim računanjem. Predmet konstruktivno nadgrajuje znanja algebre in analize.</p>	<p>numerical solution of various mathematical problems. In addition to mathematics, numerical methods are used in many other fields when the problem can be described by a mathematical model and a result in a numerical form is required. Many problems can not be solved analytically but only numerically. Also, in some cases, the numerical solution is much more economical than the analytical one.</p> <p>Reflection: Understanding of the theory from the applications.</p> <p>Transferable skills: The ability to solve mathematical problems using a computer. Understanding the differences between the exact and the numerical computation. The subject enriches constructively the knowledge of algebra and analysis.</p>

Metode poučevanja in učenja:

<p>Predavanja, vaje, domače naloge, konzultacije</p>

Learning and teaching methods:

<p>Lectures, exercises, homework, consultations</p>

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in projektno delo) Končno preverjanje (pisni in ustni izpit) Ocene: 6-10 pozitivno, 1-5 negativno</p>	<p>50% 50%</p>	<p>Type (examination, oral, coursework, project): Continuing (homework, midterm exams, project work)Final (written and oral exam) Grading: 6-10 pass, 1-5 fail (according to the Statute of UL)</p>
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(v skladu s Statutom UL)

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Reference nosilca / Lecturer's references:

Bor Plestenjak:

- 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]
- PLESTENJAK, Bor, BAREL, Marc van, CAMP, Ellen van. A Cholesky LR algorithm for the positive definite symmetric diagonal-plus-semiseparable eigenproblem. V: CHING, Wai-Ki (ur.). Second international conference on structured matrices : Hong Kong Baptist University, 08-11 June 2006, (Linear algebra and its applications, ISSN 0024-3795, Vol. 428, Issues 2-3, 2008). New York: North Holland, 2008, vol. 428, iss. 2-3, str. 586-599 [COBISS.SI-ID 14475097]
- GHEORGHIU, C. I., HOCHSTENBACH, Michiel E., PLESTENJAK, Bor, ROMMES, Joost. Spectral collocation solutions to multiparameter Mathieu's system. Applied mathematics and computation, ISSN 0096-3003. [Print ed.], 2012, vol. 218, iss. 24, str. 11990-12000 [COBISS.SI-ID 16484185]

Emil Žagar:

- 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, 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]
- JAKLIČ, Gašper, KOZAK, Jernej, KRAJNC, Marjetka, VITRIH, Vito, ŽAGAR, Emil. Hermite geometric interpolation by rational Bézier spatial curves. SIAM journal on numerical analysis, ISSN 0036-1429, 2012, vol. 50, no. 5, str. 2695-2715 [COBISS.SI-ID 16449369]