Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Numerična analiza
Course title:	Numerical Analysis

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Matematika, 2. stopnja		**1. ali 2.**	**2. ali 4.**
Mathematics, 2nd degree		**1. or 2.**	**2. ali 4.**

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja **Lectures**	**Seminar** **Seminar**	**Sem. vaje** **Tutorial**	**Lab. vaje** **Laboratory work**	**Teren. vaje** **Field work**	**Samost. delo** **Individ. work**	**ECTS**
60		**30**	**15**		**195**	**10**

Nosilec predmeta / Lecturer: Valerij ROMANOVSKIJ

Jeziki / Languages:	
Predavanja / Lectures:	SLOVENSKO/SLOVENE
Vaje / Tutorial:	SLOVENSKO/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Poznavanje matematične analize.

Prerequisits:

Knowledge of mathematical analysis.

Vsebina:

1. Analize numeričnega računanja.
2. Reševanje nelinearnih enačb: Reševanje sistemov nelinearnih enačb.
3. Diferenčne operatorji in diferenčne enačbe.
4. Sistemi linearnih enačb. Iterativne metode.
5. Problem lastnih vrednosti: Schurov in Gershgorinov izrek. Simetrični in nesimetrični problem lastnih vrednosti.
6. Navadne diferencialne enačbe: Lastnosti rešitev in stabilnost rešitev. Picardova

Content (Syllabus outline):

1. Analysis of numerical computing.
2. Nonlinear equations solving: Systems of nonlinear equations.
3. Difference equations and difference operators.
4. Systems of linear equations. Iterative methods.
5. Eigenvalues computation problem: Schur's and Gershgorin's theorems. Symmetric and non-symmetric eigenvalue problem.

metoda. Metode Runge-Kutta. Večkoračne metode. Robni problem. Sistemi diferencialnih enačb. 7. Numerično odvajanje:Richardsonova ekstrapolacija. 8. Polinomske sistemi: Groebnerjeva baza. Raznoterost polinomskega ideala in njene lastnosti. Razcep raznoterosti. 9. Parcialne diferencialne enačbe.	6. Ordinary differential equations: Properties of solutions and stability of solutions. Runge-Kutta methods. Multi-step methods. Boundary-value problems. Systems of differential equations. 7. Numeric derivation: Richardson's extrapolation. 8. Polynomial systems: Groebner basis, Variety of polynomial ideal and its properties. Decomposition of varieties. Modular methods. 9. Partial differential equations.

Temeljni literatura in viri / Readings:

Z. Bohte, Numerično reševanje nelinearnih enačb, DMFA Slovenije, Ljubljana, 1993.
Z. Bohte, Numerično reševanje sistemov linearnih enačb, DMFA Slovenije, Ljubljana, 1994.
D. Kincaid, W. Cheney: Numerical Analysis, Brooks/Cole, Pacific Grove, 1996.
E. Zakrajšek, Uvod v numerične metode, druga izdaja, DMFA Slovenije, Ljubljana, 2000.
V. G. Romanovski and Douglas S. Shafer, The Center and Cyclicity Problems. A Computational Algebra Approach, Boston-Basel-Berlin: Birkhauser, 2009.
G. Teschl, Ordinary Differential Equations and Dynamical Systems. Providence: American Mathematical Society, 2012.

Cilji in kompetence:	**Objectives and competences:**
Poglobiti znanje iz zahtevnejših konceptov in rezultatov s področja numerične analize – simbolnega računanja in numeričnih metod.	To deepen the knowledge of more demanding concepts and results from numerical analysis – symbolic mathematics and numerical methods.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Poglobiti znanje iz zahtevnejših numeričnih metode in njihovih uporabnih vrednosti. • Prepoznati praktične probleme in njihovo modeliranje z orodji numerične matematike. Prenesljive/ključne spretnosti in drugi atributi: • Prenos znanja numeričnih metod na druga področja (računalništvo, statistika, optimizacija, ...)	Knowledge and Understanding: • To deepen the knowledge of more demanding numerical methods and their applications. • To recognize practical problems and their modeling with numerical mathematics tools. Transferable/Key Skills and other attributes: • Knowledge transfer of numerical methods into other fields (computer science, statistics, optimization, …)

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja	• Lectures

• Seminarske vaje • Izdelava seminarske naloge	• Tutorial • Seminar (project) work

Načini ocenjevanja:		**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) • Opravljena seminarska naloga • Pisni izpit – problemi • Pisni izpit – teoretija Pisni izpit - problemi se lahko nadomesti z dvema delnima testoma (sprotni obveznosti) Pisni izpit - teorja se lahko nadomesti z dvema delnima testoma (sprotni obveznosti) Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.	Delež (v %) / Weight (in %) 10% 50% 40%	Type (examination, oral, coursework, project): • Completed seminar (project) work • Written exam – problems • Written exam – theory Written exam – problems can be replaced by two parital tests (mid-term testing) Written exam – theory can be replaced by two parital tests (mid-term testing) Each of the mentioned commitments must be assessed with a passing grade.
Reference nosilca / Lecturer's references:		

1. ROMANOVSKI, Valery, SHAFER, Douglas. *The center and cyclicity problems : a computational algebra approach*. Basel: Birkhäuser, 2009. XV; 330 str. ISBN 978-0-8176-4726-1. [COBISS.SI-ID 62709761]
2. ROMANOVSKI, Valery, PREŠERN, Mateja. An approach to solving systems of polynomials via modular arithmetics with applications. *Journal of Computational and Applied Mathematics*, ISSN 0377-0427. [Print ed.], 2011, vol. 236, iss. 2, str. 196-208. doi: 10.1016/j.cam.2011.06.018. [COBISS.SI-ID 18552584]
3. PAUSCH, Marina, GROSSMANN, Florian, ECKHARDT, Bruno, ROMANOVSKI, Valery. Groebner basis methods for stationary solutions of a low-dimensional model for a shear flow. *Journal of nonlinear science*, ISSN 0938-8974. [Print ed.], 2014, vol. 24, iss. 5, str. 935-948, doi: 10.1007/s00332-014-9208-7. [COBISS.SI-ID 20920584]
4. MAHDI, Adam, ROMANOVSKI, Valery, SHAFER, Douglas. Stability and periodic oscillations in the Moon-Rand systems. *Nonlinear analysis: real world applications*, ISSN 1468-1218, 2013, vol. 14, iss. 1, str. 294-313. [COBISS.SI-ID 19482120]
5. BOULIER, F., HAN, M., LEMAIRE, F., ROMANOVSKI,V. Qualitative investigation of a gene model using computer algebra algorithms. *Programming and computer software*, ISSN 0361-7688, 2015, vol. 41, no. 2, str. 105-111, doi: 10.1134/S0361768815020048. [COBISS.SI-ID 21355784]