



Univerza v Mariboru



Univerza v Mariboru

Fakulteta za naravoslovje in  
matematiko

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

|                      |                    |
|----------------------|--------------------|
| <b>Predmet:</b>      | Numerična analiza  |
| <b>Course title:</b> | Numerical Analysis |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|-----------------------------------------------------------|-------------------------------|-------------------------|----------------------|
| Matematika, 2. stopnja                                    |                               | 1. ali 2.               | 2. ali 4.            |
| Mathematics, 2 <sup>nd</sup> degree                       |                               | 1. or 2.                | 2. ali 4.            |

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

| Predavanja<br>Lectures | Seminar<br>Seminar | Sem. vaje<br>Tutorial | Lab. vaje<br>Laboratory work | Teren. vaje<br>Field work | Samost. delo<br>Individ. work | ECTS |
|------------------------|--------------------|-----------------------|------------------------------|---------------------------|-------------------------------|------|
| 60                     |                    | 30                    | 15                           |                           | 195                           | 10   |

Nosilec predmeta / Lecturer:

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

SLOVENSKO/SLOVENE

SLOVENSKO/SLOVENE

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

Poznavanje matematične analize.

Prerequisites:

Knowledge of mathematical analysis.

Vsebina:

1. Analize numeričnega računanja.
2. Reševanje nelinearnih enačb: Reševanje sistemov nelinearnih enačb.
3. Sistemi linearnih enačb. Iterativne metode.
4. Problem lastnih vrednosti: Schurov in Gershgorinov izrek. Simetrični in nesimetrični problem lastnih vrednosti.
5. Aproksimacije funkcij: Zlepki. Aproksimacije periodičnih funkcij. Druge aproksimacijske metode in analiza napake

Content (Syllabus outline):

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

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| <p>aproksimacije.</p> <p>6. Numerično integriranje: Gaussove kvadrature formule. Rombergova metoda. Mnogoterni integrali.</p> <p>7. Navadne diferencialne enačbe: Metoda Taylorjeve vrste. Eulerjeva metoda in posplošitve. Metode Runge-Kutta. Večkoračne metode. Robni problem. Sistemi diferencialnih enačb.</p> <p>8. Numerično odvajanje: Richardsonova ekstrapolacija.</p> <p>9. Parcialne diferencialne enačbe.</p> <p>10. Metode končnih elementov.</p> | <p>approximation methods and error analysis of approximations.</p> <p>6. Numerical integration: Gaussian quadrature. Romberg integration. Variety integration.</p> <p>7. Ordinary Differential equations: Taylor's series method. Euler's method and generalizations. Runge-Kutta methods. Multi-step methods. Boundary-value problems. Systems of differential equations.</p> <p>8. Numeric derivation: Richardson's extrapolation.</p> <p>9. Partial differential equations.</p> <p>10. Finite element methods.</p> |
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### 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.  
W.H. Press, [B.P. Flannery](#), [S.A. Teukolsky](#), [W.T. Vetterling](#): Numerical Recipes in C, Cambridge University Press, New York, 2002.  
E. Zakrajšek, Uvod v numerične metode, druga izdaja, DMFA Slovenije, Ljubljana, 2000.

### Cilji in kompetence:

Poglobliti znanje iz zahtevnejših konceptov in rezultatov s področja numerične analize – simbolnega računanja in numeričnih metod.

### Objectives and competences:

To deepen the knowledge of more demanding concepts and results from numerical analysis – symbolic mathematics and numerical methods.

### Predvideni študijski rezultati:

Znanje in razumevanje:

- Poglobliti znanje iz zahtevnejših numeričnih metode in njihovih uporabnih vrednosti.
- Prepoznati praktične probleme in njihovo modeliranje z orodji numerične matematike.

Prenosljive/ključne spretnosti in drugi atributi:

- Prenos znanja numeričnih metod na druga področja (računalništvo, statistika, optimizacija, ...)

### Intended learning outcomes:

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:

- Predavanja
- Seminarske vaje
- Izdelava seminarske naloge

### Learning and teaching methods:

- Lectures
- Tutorial
- Seminar (project) work

**Načini ocenjevanja:****Assessment:**

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| <p>Način (pisni izpit, ustno izpraševanje, naloge, projekt)</p> <ul style="list-style-type: none"><li>• Opravljena seminarska naloga</li><li>• Pisni test – praktični del</li><li>• izpit – teoretični del</li></ul> <p>Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.</p> <p>Pozitivna ocena pri pisnem testu je pogoj za pristop k izpitu.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>Delež (v %) /<br/>Weight (in %)</p> <p>10%<br/>50%<br/>40%</p> | <p>Type (examination, oral, coursework, project):</p> <ul style="list-style-type: none"><li>• Completed seminar (project) work</li><li>• Written test – practical part</li><li>• exam – theoretical part</li></ul> <p>Each of the mentioned commitments must be assessed with a passing grade.</p> <p>Passing grade of the written test is required for taking the exam.</p> |
| <b>Reference nosilca / Lecturer's references:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                   |                                                                                                                                                                                                                                                                                                                                                                              |
| <p>1. PRNAVER, Katja, ZMAZEK, Blaž. On total chromatic number of direct product graphs. <i>J. appl. math. comput. (Internet)</i>, 2010, issue 1-2, vol. 33, str. 449-457.<br/><a href="http://dx.doi.org/10.1007/s12190-009-0296-8">http://dx.doi.org/10.1007/s12190-009-0296-8</a>, doi: <a href="https://doi.org/10.1007/s12190-009-0296-8">10.1007/s12190-009-0296-8</a>. [COBISS.SI-ID <a href="#">17523720</a>]</p> <p>2. ZMAZEK, Blaž, ŽEROVNIK, Janez. The Hosoya-Wiener polynomial of weighted trees. <i>Croat. chem. acta</i>, 2007, vol. 80, 1, str. 75-80. [COBISS.SI-ID <a href="#">11338518</a>]</p> <p>3. ZMAZEK, Blaž, ŽEROVNIK, Janez. Weak reconstruction of strong product graphs. <i>Discrete math.</i> [Print ed.], 2007, vol. 307, iss. 3-5, str. 641-649.<br/><a href="http://dx.doi.org/10.1016/j.disc.2006.07.013">http://dx.doi.org/10.1016/j.disc.2006.07.013</a>. [COBISS.SI-ID <a href="#">14184025</a>]</p> <p>4. ZMAZEK, Blaž, ŽEROVNIK, Janez. On domination numbers of graph bundles. <i>J. Appl. Math. Comput., Int. J.</i>, 2006, vol. 22, no. 1/2, str. 39-48. [COBISS.SI-ID <a href="#">10636822</a>]</p> <p>5. ZMAZEK, Blaž, ŽEROVNIK, Janez. On generalization of the Hosoya-Wiener polynomial. <i>MATCH Commun. Math. Comput. Chem. (Krag.)</i>, 2006, vol. 55, no. 2, str. 359-362. [COBISS.SI-ID <a href="#">13990745</a>]</p> |                                                                   |                                                                                                                                                                                                                                                                                                                                                                              |