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|  **UNIVERSITY OF NIŠ** |
| **Course Unit Descriptor** | **Faculty**  | Faculty of Sciences and Mathematics |
| **GENERAL INFORMATION** |
| Study program  | **Computer Science** |
| Study Module (if applicable) |  |
| Course title | Scientific computation |
| Level of study | [ ] Bachelor [ ]  Master’s [x]  Doctoral |
| Type of course | [ ]  Obligatory [x]  Elective |
| Semester  |  [x]  Autumn [ ] Spring |
| Year of study  | 1 |
| Number of ECTS allocated |  |
| Name of lecturer/lecturers | dr Marko Petković |
| Teaching mode |  [x] Lectures [ ] Group tutorials [ ]  Individual tutorials [ ] Laboratory work [ ]  Project work [ ]  Seminar [ ] Distance learning [ ]  Blended learning [ ]  Other |
| **PURPOSE AND OVERVIEW (max. 5 sentences)** |
| *Introduction to the construction and implementation of the numerical methods, and applications to the practical problems in natural, technical and social sciences.* *Student should be familiar with the basic and advanced numerical methods. Student should also be able to efficiently implement theese methods on solving the concrete practical problems in natural sciences (physics, biology, chemistry, etc), technical sciences, finantial mathematics, and other disciplines.* |
| **SYLLABUS (brief outline and summary of topics, max. 10 sentences)** |
| **Numerical methods in linear algebra.** Methods based on the LU and LDU factorization. Singular value decomposition. Large-scale sparse systems. QR factorization. Rapid algorithms for matrix-matrix multiplication and (generalized) inverse matrix computation. Preconditioning methods. Conjugate gradient methods.**Non-linear equations and optimization methods.** Newton-Raphson method. Multistep methods. Methods of the higest convergence rate. Non-linear optimization methods. KKT conditions. Metropolis algorithm (Simulated Annealing). Practical application of the optimization methods.**Function value evaluation.** Fast algorithms for arithmetic operations. Algorithms for high-precision computation of important constants and elementary functions. Evaluation of the special functions. Function approximation by polynomial and rational functions. Least-squares methods.**Pseudorandom numbers.** Linear shift register method. Mersenne twister method. Pseudorandom numbers in normal and arbitrary distribution. Monte-Carlo method.**Signal processing.** Signal synthesis, detection and modelling. Fast Fourier transform (FFT) and algorithms. Wavelets. Methods for loosy and loseless data compression. Sound coding and compression.  |
| **LANGUAGE OF INSTRUCTION** |
| [x] Serbian (complete course) [x]  English (complete course) [ ]  Other \_\_\_\_\_\_\_\_\_\_\_\_\_ (complete course)[ ] Serbian with English mentoring [ ] Serbian with other mentoring \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **ASSESSMENT METHODS AND CRITERIA** |
| **Pre exam duties** | **Points** | **Final exam** | **points** |
| **Activity during lectures** |  | **Written examination** |  |
| **Practical teaching** |  | **Oral examination** | **50** |
| **Teaching colloquia** | **50 (25+25)** | **OVERALL SUM** | **100** |
| **\*Final examination mark is formed in accordance with the Institutional documents** |