**Study programmes**: Bachelor studies – Mathematics

**Course name**: M4.04 – Numerical Methods

**Lecturers**: Zorica Stanimirović

**Status**: Optional

**ECTS**: 5

**Attendance prerequisites**: -

**Course aims**:
Acquisition of general and specific knowledge in Interpolation, Approximation Theory, and Numerical Methods for Solving Differential Equations.

**Course outcome**:
At the end of the course, a student will be able to choose the most suitable approximation method for a given problem from practice, in cases that function to be approximated is given either by analytic expression or by discrete set of values. Further, student will gain knowledge needed to formulate the correct numerical model, to implement adequate numerical method (write computer program), and to find solution with given precision. Special attention is devoted to harmonic and wavelet analysis, as they represent important mathematical tools for signal and image processing. Student will be capable of transforming discrete signal in its frequency domain by applying Fast Fourier Transformation (FFT) and finding multiresolution decomposition of a signal by using Fast Wavelet Transformation (FWT). Student will gain knowledge required to solve simple mathematical models of physical processes described by differential equations. A student will be capable of identifying problem type, formulating adequate mathematical model, and choosing adequate numerical methods. Then, student will be able to solve the formulated model by implementing adequate numerical methods in computer program, and to estimate the error of obtained solution. Practical aspects of the course are realized within an individual seminar work that assumes implementation of numerical methods in computer program and the use of existing software packages.

**Course content**:
- Hermite Interpolation, Spline Interpolation
- Mean-square Approximation.
- Discrete Fourier Transformation (DFT). Fast Fourier Transformation (FFT). Fast Wavelet Transformation (FWT).
- Uniform Approximation. Polynomilas with Minimal Distance from Zero.
- Cauchy problems for Ordinary Differential Equations: Approximation Methods, Runge-Kutta Methods, Multistep, Multivalue, and Predictor-Corrector Methods.
- Boundary Value Problems for Ordinary Differential Equations (ODE): Shooting Method, Finite Difference Method, Variation Methods, Finite Element Method.
- Integral Equations: Sequential Aproximation Method, Degeneartive Kernels Method, Methods based on Quadrature Formulae, Variation Methods квадратурних формула, варијационе методе.
- Foundations of Numerical Methods for Solving Partial Differential Equations (PDE), based on Numerical Methods for Solving ODE.

**Literature**:


Radunović D., *Numeričke metode*, Akademska misao, 2004.
Radunović D., Samardžić A., Marić F., *Numeričke metode - zbirka zadataka kroz C, Matlab i Fortran,* Akademska misao, 2005.
Jovanović, B., Radunović, D., *Numerička analiza,* Matematički fakultet, 2003.
Burden, R.L., Faires, J.D., *Numerical Analysis*, Brooks/Cole, 2001.
Radunović, D., *Wavelets: from math to practice*. Springer Publishing Company, Inc., 2009.


| **Number of hours: 5** | **Lecures: 3** | **Excersises: 2** | **Laboratory: -** | **Research: -** |
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**Teaching and learning methods**: Frontal teaching/ Group work/ Practical work

| Assessment (maximal 100 points) | | | |
|---|---|---|---|
| **Course assignments** | **points** | **Final exam** | **points** |
| Lectures | 5 | Written exam | 20 |
| Exercises / Tutorials | 5 | Oral exam | 40 |
| Colloquia | 30 | | |