Course title: Differential and integral equations	Neptun code: GEMAN411-a
Course coordinator: Peter Varga, PhD, associate professor	
type and number of lesson: weekly lectures, 2 hours/week	
method of accountability: practical mark	
curriculum location of the subject: both of autumn and spring	
pre-study conditions: No formal conditions, however the knowledge of intermediate level calculus is assumed.	

The task and purpose of the subject:

The main objective of the course is to provide some theoretical and practical background to the subject of differential equations. That includes for example existence theorems for ordinary differential equation (ODE) using the theory of integral equations, and also includes topics like numerical methods for solving them as well. For a complete listing of the topics, see the next item. It is impossible to cover all of them in a semester, the choice of the material depends on the background and interest of the students. Whenever there is a demand for it, the course tries to provide assistance for the sudents in those part of their studies that are connected to the subject of differential equations.

Course description:

1. First order ODE as an integral equation. Existence theorems for the solution of the DE.
2. Runge-Kutta and multistep methods. Error estimates for Euler's method.
3. Behaviour of nearby solutions of ODE. Lyapunov exponent. Chaotic versus regular dynamics.
4. Periodic solution of ODE. Perturbation theory.
5. Boundary value problems for ODE as applied for strings and beams.
6. Variational calculus. Examples in point mechanics, steady states of strings and beams. Partial differential equation (PDE) examples: String and beam vibrations, electrodynamics, inviscid fluids and linear elasticity.
7. Finite element methods. Its application in this course is usually limited to one dimensional objects like strings and beams.
8. Finite difference methods of PDE. Applications for the transport, heat and wave equations in one spatial dimension.
9. Distributions, Green functions. One dimensional examples.
10. Self-adjoint boundary value problems, Fourier and orthogonal series.
11. PDE in curved coordinate systems.
12. Laplace operator in spherical coordinates, special and Bessel functions.
13. Special solutions of PDE: plane wave and rotationally symmetric solutions.

Required literature:

1. Peter Olver: Introduction to partial differential equations. (Springer, 2014)
2. I. Stakgold and M. Holst: Green's functions and boundary value problems. (Wiley, 2011)
3. C. Edwards and D. Penney. *Elementary Differential Equations with Boundary Value Problems.* (Prentice Hall, 2003)

Recommended literature:

1. Differential equations. MIT-OCW course notes.

https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/

2. Paul Dawkins: Differential equations.
   https://tutorial.math.lamar.edu/classes/de/de.aspx
3. The previous items are especially useful for students with little background for this course. Most of the presented material of the lectures have class notes at the website of the course.