University of Óbuda John von Neumann Faculty of Informatics			*Institute of Applied Mathematics*	
Name and code: *Differential equations* NMXDE1PMNE			**Credits:3** *2022/23 year I. semester*	
Subject lecturers: Dr. Zoltán Léka				
Prerequisites (with code):	-			
Weekly hours:	Lecture: 2	Seminar.: 1	Lab. hours: 0	Consultation: 0
Way of assessment:	Two midterm exams + written exam			

Course description:

Goal: To provide an overview of the fundamental concepts of one and two-dimensional dynamical systems. Moreover, the course discusses the methods of calculus of variations with applications in mechanics, and elements of PDEs (heat and wave equations in Euclidean spaces)

Course description: Dynamics of first and second order differential equations, stability of fixed points through linearization. Energy methods and Lyapunov direct methods. Periodic solutions, limit cycles. Calculus of variations. Hamiltonian and Lagrangian systems, Legendre transform. Elements of PDEs: method of characteristics, heat equation, wave equation.

Lecture schedule

Education week	*Topic*
1.	First-order ordinary differential equations: linear, exact and separable systems
2.	Dynamics of first order autonomous differential equations, fixed points.
3.	Dynamics of second order systems: Jacobian matrix, characterization of fixed points through linearization, stability
4.	Energy methods, Lyapunov s theorems on stability
5.	Periodic solutions, limit cycles: divergence criterion, Poincaré-Bendixson theorem
6.	1st written exam
7.	Introduction to variational calculus: brachistochrone problem, Euler-Lagrange equations
8.	Calculus of variations in mechanics, Hamiltonian systems
9.	Hamiltonian and Lagrangian systems, Legendre transformation
10.	Partial differential equations: method of characteristics
11.	Second order partial differential equations, classification
12.	Laplace operator, Dirichlet energy and the heat equation
13.	2nd written exam
14.	Goursat- and Cauchy problems, the wave equation.

Midterm requirements

Education week	*Topic*
	Weekly home assignments, and two midterms

2022. 06. 13.

Final grade calculation methods

Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	satisfactory (3)
51%-62<%	passed (2)
0%-50<%	failed (1)

Type of exam

Written exam of 180 mins

Type of replacement

One midterm of the semester can be replaced at the final week

References

R. Kent Nagle, Edward B. Saff, Arthur David Snider: Foundamentals of Differential Equations and Boundary Value Problems, 8th Edition, Addison-Wesley, 2011.

D. Strogatz: Non-linear dynamics and chaos, Westview Press, 2001.

Recommended:

E. Lieb, M. Loss: Analysis, Amer. Math. Soc., Providence, 2001.
Simon J. Malham: An introduction to Lagrangian and Hamiltonian mechanics, 2016.