Institute of Applied Mathematics			Semester 3 of the curriculum 2026-27-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Partial differential equations	NMXPD1EMNF	6	full-time	2	0	2
Responsible person for the subject: Prof. Dr. TAKÁCS, Márta			Classification: professor			
Subject lecturer(s): Dr. MESTYÁN, Márton						
Prerequisites:	NMXDE1EMNF	Differential equations				
Way of the assessment:	exam					

Course description	
Goal:	Introduction to the theory of PDEs and their methods of solution with the help of generalized functions (distributions).
Course description:	Initial and boundary value problems for hyperbolic and parabolic equations, weak solutions to elliptic boundary problems, Generalized functions, Bessel functions, fundamental solutions, Cauchy problems.

Lecture schedule	
Education week	Topic
1.	First-order PDEs with a linear principal part. Method of characteristics.
2.	Classification of second-order PDEs with a linear principal part in two variables.
3.	The wave equation and the Klein-Gordon equation. Initial and boundary value problems for hyperbolic equations.
4.	The heat equation and the Schrödinger equation of a free particle. Initial and boundary value problems for parabolic equations.
5.	Laplace's equation, Helmholtz equation. Elliptic boundary value problems.
6.	Test functions and generalized functions (distributions).
7.	(1st midterm test.) Singular distributions. Derivatives of distributions.
8.	Multiplication of a distribution by a smooth function. Direct product of distributions. Convolutions of functions and distributions.
9.	Rapidly decreasing and slowly increasing functions and distributions. Fourier transforms of functions. Inhomogeneous linear coordinate transformation of distributions. Fourier transforms of distributions.
10.	Fundamental solutions, particular solutions to inhomogeneous equations. Fundamental solutions to ordinary linear differential operators with constant coefficients. Fundamental solutions to first-order PDEs.
11.	Fundamental solutions of the wave operator, the Klein-Gordon operator and the heat operator. Bessel functions of order 0.
12.	Fundamental solutions to the Laplace operator and the Helmholtz operator.
13.	(2nd midterm test.) Cauchy problems.
14.	(Retake/preparation for the exam.)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Students have to write two midterm tests. Each test is worth 50 points. To get the signature, at least 40 points must be achieved in the two tests *together.*

Assessment schedule	
Education week	Topic
7	Material of weeks 1 to 6
13	Material of weeks 7 to 12

14	Retake.
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	One of the two midterm tests can be retaken on Week 14. If the student does not reach at least 40 points on the two midterm tests together, it is possible to take a signature retake exam. The signature retake exam will take place in the first or the second week of the exam period.
Type of the exam (to be filled out only for subjects with exams)	
Written exam.	
Calculation of the exam mark (to be filled only for subjects with exams)	

The exam is worth 50 points. The final score is calculated as

Final score = (1^{st} midterm score + 2^{nd} midterm score) / 2 + exam score.

If it is more advantageous for the student, the final score is calculated as.

Final score = 2 * exam score

Final grades are assigned according to the following score ranges:

- 89-100: excellent (5),
- 76-88: good (4),
- 64-76: average (3),
- 50-63: pass (2),
- 0-49: fail (1).

Recommended grades:

- Only students who are present in at least 80% of the classes can get a recommended grade.
- Students who reach at least 89 points on the two midterms together get a recommended grade of Excellent (5).
- Students who reach at least 76 points on the two midterms together get a recommended grade of Good (4).

References	
Obligatory:	• Walter A. Strauss: Partial differential equations – An introduction, Wiley/New York, 1992 • V.S. Vladimirov: Equations of Mathematical Physics, Mir/ Moscow, 1971 and M. Dekker/New York, 1971. • Material uploaded to the Moodle e-learning system
Recommended:	• V.I. Arnold: Lectures on Partial Differential Equations, Springer, 2004.
Other references:	• Material uploaded to the Moodle e-learning system