Partial differential equations of mathematical physics

Wasyl Kowalczuk, Ph.D., Dr. Habil.

Department of Theory of Continuous Media

The aim of this cycle of lectures and laboratory exercises is to acquaint the students with the basic types of partial differential equations (PDEs) as mathematical models of many natural phenomena occuring in space and time, like, e.g., wave equation, heat diffusion, and steady state of heat equation. During the course will be discussed main methods of solution of linear PDEs of first/second orders and their systems (i.e., method of characteristics, separation of variables, integral transform, etc.) together with the classification of different types of initial/boundary conditions (Dirichlet, Neumann, Robin). The full understanding of the presented material demands from the students at least the basic knowledge of ordinary differential equations (ODEs).

Main topics:

1. Introduction and examples of applications.
2. Equations of first order: linear, quasilinear, nonlinear. Hamilton-Jacobi theory.
3. Classification of linear equations of second order: hyperbolic, parabolic, elliptic.
4. Hyperbolic equations: wave equation, characteristics, initial-boundary value problems.
5. Fourier transform, its application in analysis of partial differential equations.
6. Parabolic equations: heat diffusion, method of separation of variables.
7. Elliptic equations: steady state of heat equation, Laplace/Poisson equation, Green function.

The total number of lecture hours: 30, laboratory exercises: 30 hours, self-teaching: 45 hours, direct tutoring and consultations: 15 hours.

ECTS Points: 4.