Partial differential equations. Partial differential equations (PDEs for short) are used for the mathematical formulation a wide variety of phenomena such as heat transfer, diffusion, sound, electrostatics, electrodynamics, fluid dynamics, elasticity, gravitation, bacteria colony growth, etc. These seemingly distinct physical phenomena are unified by similar PDEs used for their description. A PDE has the form

\[ F \left( x_1, x_2, ..., u, \frac{\partial u}{\partial x_1}, \frac{\partial u}{\partial x_2}, ..., \frac{\partial^2 u}{\partial x_1^2}, ... \right) = 0; \]

it contains multivariable functions \( u \) and their partial derivatives.

3150-002. The course introduces main types of linear PDEs, discusses basic physical laws on which they are based, introduces mathematical tools for the solution of PDEs, provides numerous examples. Texts:

(1) Lecture Notes by William Nesse (uploaded in the class canvas page "file" directory).


Office Hour: Thursdays, after class, 11:00-12:00, LCB 225

The grade is based on homework (40%), two midterms, and the final exam.

List of topics:

(1) Derivation of partial differential equations (PDE) for transport and diffusion (conservation of mass, flux, singular sources).

(2) Mathematical tools: functional spaces, eigenfunctions, orthogonality of functions, least-square approximation.

(3) Fourier series: Approximation of functions, convergence, energy spectrum, differentiation and integration of series.

(4) Solutions of PDE for transport and diffusion (modeling of transport and diffusion, equilibrium, and time-dependent temperature in rods, heat sources).

(5) PDE for oscillations and waves: Wave equation, d’Alembert solution, reflection, and Fourier series solution.
