One-year course on *Partial Differential Equations in Continuum Transport Processes I and II for the graduate students having strong background in mathematics and physics.*

Name of Lecturer/s: *Professors Boris Zaltzman and Golan Bel*

Pre-Requirements: *Ordinary Differential Equations, Advanced Analysis*

Grade: *3 Assignments (50%) + Final Examination (50%) 1-2-4060 (3 credits)*

Partial Differential Equations in Continuum Transport Processes I

Lecture 1. Introduction. Modeling convection and first order PDE. Linear first order PDE with constant coefficients: Characteristics and solution to Cauchy problem.
Lecture 2. Characteristics and discontinuities. First integrals and general solution.
Lecture 3. General second-order PDE with constant coefficients. Classification and canonical form.
Lecture 4. Modeling vibration of elastic string and diffusion process. Derivation of basic equations of mathematical physics.
Lecture 5,6. Wave equation. General solution. Solution to Cauchy problem. Boundary conditions and initial boundary value problems on half axis. Initial-boundary value problem on an interval.
Lecture 7. Energy inequality for wave and telegraph equation for a finite and infinite intervals. Characteristics and finite wave speed.
Lecture 8. Heat equation. Cauchy problem and Green function. Initial-boundary value problems on half axis. Green functions.
Lecture 9,10. Finite interval. Separation of variables in telegraph equation. Two asymptotic limits: heat equation and wave equation. Inhomogeneous problems. Duhamel principle. Long-time asymptotics for heat and telegraph equations.
Lecture 11. Maximum principle for heat equation. Uniqueness theorem. Laplace and Poisson equation. Formulation of the boundary value problem.
Lecture 12. Radially symmetrical case and potential of the point charge. Mean value theorem and maximum principle. Uniqueness theorem for Dirichlet problem.
Lecture 13. Separation of variables in circle. Poisson formula. Separation of variable in rectangle.

Bibliography:

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- *R. Courant and D. Hilbert,* Methods of Mathematical Physics, *New York: Wiley-Interscience, 1989*
- *S. L. Sobolev.* Partial Differential Equations of Mathematical Physics: *Pergamon Press, 1964*
- *C.R. Chester*, Techniques in partial differential equations. *McGraw Hill, 1971.*
- *A.N Tikhonov and A.A. Samarskii* Equations of mathematical physics. *Pergamon Press, 1963.*
- *Tveito, A., and R. Winther.* Introduction to Partial Differential Equations: A Computational Approach. *New York, NY: Springer, 1998.*
- *O. Dimon,* Foundations of Potential Theory *Berlin : Springer-Verlag, 1967*
- *R. S. Pathak*, A Course in Distribution Theory And Applications: *Alpha Science, 2001*