Partial Differential Equations

Spring Semester

LECTURER **Professor Yakov Yakubov**

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INSTRUCTOR **Yakov Yakubov**

COURSE DESCRIPTION

We are going to study classical partial differential equation of elliptic, parabolic and hyperbolic types. Boundary and initial value problems are treated, in particular, Dirichlet, Neumann and Cauchy problems. The course, in particular, covers classical separation variable method, maximum principle, well-posedness questions.

COURSE TOPICS

Week 1: String or wave equation. Initial and boundary value conditions (fixed and free boundary conditions). The d'Alembert method for an infinitely long string. Characteristics

Week 2 : Wave problems for half-infinite and finite strings.

Week 3 : Sturm-Liouville problem.

Weeks 4-5: A solution of a problem for a finite string with fixed and free boundary conditions by the method of separation of variables. The uniqueness proof by the energy method. Well-posedness of a vibrating string problem.

Week 6-7: Second order linear equations with two variables: classification of the equations in the case of constant and variable coefficients, characteristics, canonical forms. Laplace and Poisson equations. Maximum principle. Well-posedness of the Dirichlet problem.

Week 8-9: Laplace equation in a rectangle. Laplace equation in a circle and Poisson formula. A non-wellposed problem - the Cauchy problem. Green formula and its using for Neumann problems. Uniqueness of a solution of the Dirichlet problem.

Week 10-11: The method of separation of variables for the one-dimensional heat equation. Maximum principle. Uniqueness for the one-dimensional heat equation. The Cauchy problem for heat equations. Green function.

Week 12-13: Non-homogeneous heat equations, Poisson equations in a circle and non-homogeneous wave equations.

ASSIGNMENTS

75% of all homework assignments must be handed in for evaluation.

MIDTERM COURSE POLICY

A midterm exam will be scheduled in the beginning of the semester. During an examination, student shall not use books, papers, or other materials not authorized by the instructor. The midterm (for 1.5 hours) will count for 10% of the total course grade.

FINAL COURSE POLICY

The final exam will cover the entire course material and will count for 90% of the total course grade. There will be a choice of 4 out of 5 questions. The duration will be 3 hours. Students will have a first exam, Moed A. If the student does not pass, they can retake the exam, Moed B. The last exam taken will be the student's final grade for the exam.

REQUIRED READING

Tikhonov, A.N. and Samarskii, N.A: *Equations of Mathematical Physics*, Pergamon Press, Oxfort, 1963.
Weinberger, H.F, *A first Course in Partial Differential Equations*, Dover, NY, 1995.