**Differential Equations of Mathematical Physics**

Prof. Alessandro Musesti

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims at introducing the students to the theory and methods of linear partial differential equations, focusing in particular on the models studied in Mathematical Physics.

***Course content***

Semilinear partial differential equations of second order. Characteristic manifolds. Cauchy problem. Well-posed problems. Generalized solutions. Adjoint differential operators. Green’s identity.

Some functional spaces. Distributions. Convolution. Fourier transform. Generalized solutions for linear PDEs.

Laplace operator. Fundamental solution. Integral representation. Harmonic functions. Maximum principle. Dirichlet and Neumann problems. Superposition principle. Green’s function for the Dirichlet problem. Dirichlet problem in a ball. Poisson kernel.

Heat operator. Fundamental solution. Initial value problem. Mixed boundary value problem.

Wave operator. Fundamental solution. Retarded potentials and Kirchhoff formula. Uniqueness and stability theorem. Two-dimensional and one-dimensional case.

Functional methods. Eigenvalue problem for the Laplace operator. Spectral theory for compact operators. Spectrum of the Laplace operator. Fourier method for heat equation. Eigenvalues and eigenfunctions for the Laplace operator: interval, square, rectangle, circle.

***Reading list***

Lecture notes will be provided during the course.

***Teaching method***

Classroom lectures.

***Assessment method AND EVALUATION CRITERIA***

There will be an oral examination about theoretical topics and analysis of some models, aimed to evaluate the knowledge and the expertise of the student. The exam will last about 40-50 minutes.

***NOTES AND PREREQUISITES***

Some notions in Vector calculus, Ordinary differential equations and Functional analysis are required. The main useful concepts will be recalled during the course.

*Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.*