



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Functional Analysis

1819-1-F5302Q002

Aims

The aim of the course is to provide the basic tools of Mathematical Analysis useful in the study of the differential equations of Classical Physics and Quantum Mechanics.

Contents

Complex analysis. Special functions. Fourier series. Convolution. Fourier transform. Distributions and Dirac delta. Laplace transform. Elements of Calculus of Variations.

Detailed program

Complex Analysis

Holomorphic functions and harmonic functions. Cauchy's theorem. Laurent series. Residue theorem. Jordan Lemma. Calculation of integrals by means of residue theorem.

Fourier series

Reminder on series expansion. Complete orthonormal systems. Parseval formula and inversion formula. Fourier series in real and complex form.

Fourier transform and applications

Parseval formula and inversion formula. Convolution of functions. Applications to the resolution of the heat, wave and Schroedinger equation. Calculation of Fourier transforms with the residue theorem. Gaussian function. Lorentzian function. Voigt function. Distribution of Fourier transforms. Distributions. Definition and simple properties. Approximation of the Dirac delta distribution.

Special functions

Functions of Laguerre, Legendre, Bessel. Spherical harmonics.

Elements of Calculus of Variations

Functional derivative. Euler-Lagrange equation.

Laplace transform

Application of the Laplace transform to the solution of ordinary differential equations with boundary or initial conditions.

Prerequisites

Basic mathematical analysis: differential calculus for functions of one or several variables, ordinary and partial differential equations, integral calculus.

Teaching form

Lectures and exercises.

Textbook and teaching resource

K. F. Riley, M. P. Hobson and S. J. Bence. *Mathematical Methods for Physics and Engineering*, Cambridge University Press.

Further material will be suggested or distributed during the course.

Semester

First Semester 2018-19

Assessment method

Written exam: exercises and problems with open questions.

Oral exam: discussion of the written exam; solution of further exercises can be required; questions on definitions, statements and (selected) proofs of theorems.

It is possible to take the oral exam even if the result of the written exam is not sufficient.

Office hours

By appointment.
