# Program of the course: Metodi Matematici

degree in "Matematica" prof. P. Soravia, 2012/13

**1. Basic complex analysis.** Exponential in the complex plane. Complex logarithm. Complex derivative. Complex and real differentials. Holomorphic functions. Harmonic functions. Path integrals. Small and big circle theorems. Complex and real forms. Winding number. Cauchy formula for the circle. The fundamental theorem of algebra. Local primitives. Goursat Theorem. Identity theorem. Open mapping theorem. Maximum and minimum modulus. Laurent series. Isolated singularities and their order. Residues. Theorem of residues. Logarithmic indicator.

**2. Fourier Series.** Periodic functions. Riemann-Lebesgue Lemma. Trigonometric series. Fourier coefficients. $L^2(\mathbb{R})$ as an Hilbert space: scalar product, orthogonal functions. Fourier series and their real form. Dirichlet kernels, Dini condition and pointwise convergence. $L^2$ convergence of Fourier series. Normal convergence. Fejer kernels. Bessel inequality and Parseval identity. Integration of Fourier series. Periodic solutions of differential equations.

**3. Fourier Transform.** Classical Fourier transform and its properties. Regularity and order of decay at infinity. Fourier transforms of most common functions. Convolution in $L^1(\mathbb{R})$. Approximate identity. Fourier transform of a convolution. Inversion formula of Fourier transform and injectivity. Fourier transform in $L^2(\mathbb{R})$. Pointwise inversion formula. Overview of convolution and Fourier transform in several variables. Use of Fourier transform to solve differential and integral equations.

**Teference texts.**
Prof. De Marco's notes downloadable from the web site
*http://www.math.unipd.it/∼gdemarco/Metodi/*
Analisi2, G. De Marco, Zanichelli.
Downloadable notes of the lectures available after registration from the web site *http://elearning.math.unipd.it*