Analysis

Semester I

- Abstract measures and integration, monotone and dominated convergence theorems, product measures, theorems of Fubini and Tonelli, integration in polar coordinates.
- Bounded linear maps on Banach spaces, Hahn-Banach extension theorem, dual spaces, Riesz representation theorems for $L_p(X)$ and $C_c(X)$.
- Hilbert spaces, complete orthonormal systems, fourier expansion, Parseval's theorem, compact operators and the spectral theorem for compact self-adjoint operators.
- Holomorphic functions, Cauchy's integral formula and power series representation, Morera's theorem, Schwarz reflection principle. Zeros and singularities, the residue formula, the argument principle and applications: Rouche's theorem, open mapping theorem, maximum modulus theorem. Schwarz lemma, the automorphisms of the disc and the upper half plane.

Semester II

- Signed measures and Radon-Nikodym theorem, functions of bounded variations and absolutely continuous functions, derivatives of measures
- Uniform boundedness principle, closed graph theorem, open mapping theorem, the weak topology, the second dual and the weak* topology
- Test functions and distributions, calculus with distributions, localization, supports of distribution, distributions as derivatives, convolutions, Fourier transform, inversion theorem, Plancherel theorem, tempered distributions, Paley-Wiener theorems
- The homotopy version of Cauchy's theorem and existence of primitives on simply connected domains. Conformal mappings, Riemann mapping theorem. Infinite product and Weierstrass factorization theorem. Analytic continuation along a curve, monodromy theorem, analytic covering maps, Picard theorem

References
- L.V. Ahlfors: Complex Analysis
- J.B. Conway: A Course in Functional Analysis
- J.B. Conway: Functions of one Complex Variable
- G.B. Folland: Real analysis
- B.V. Limaye: Functional Analysis
- W. Rudin: Functional Analysis
- W. Rudin: Real and Complex Analysis
- E.M. Stein and R. Shakarchi: Real Analysis
- E.M. Stein and R.Shakarchi: Complex Analysis